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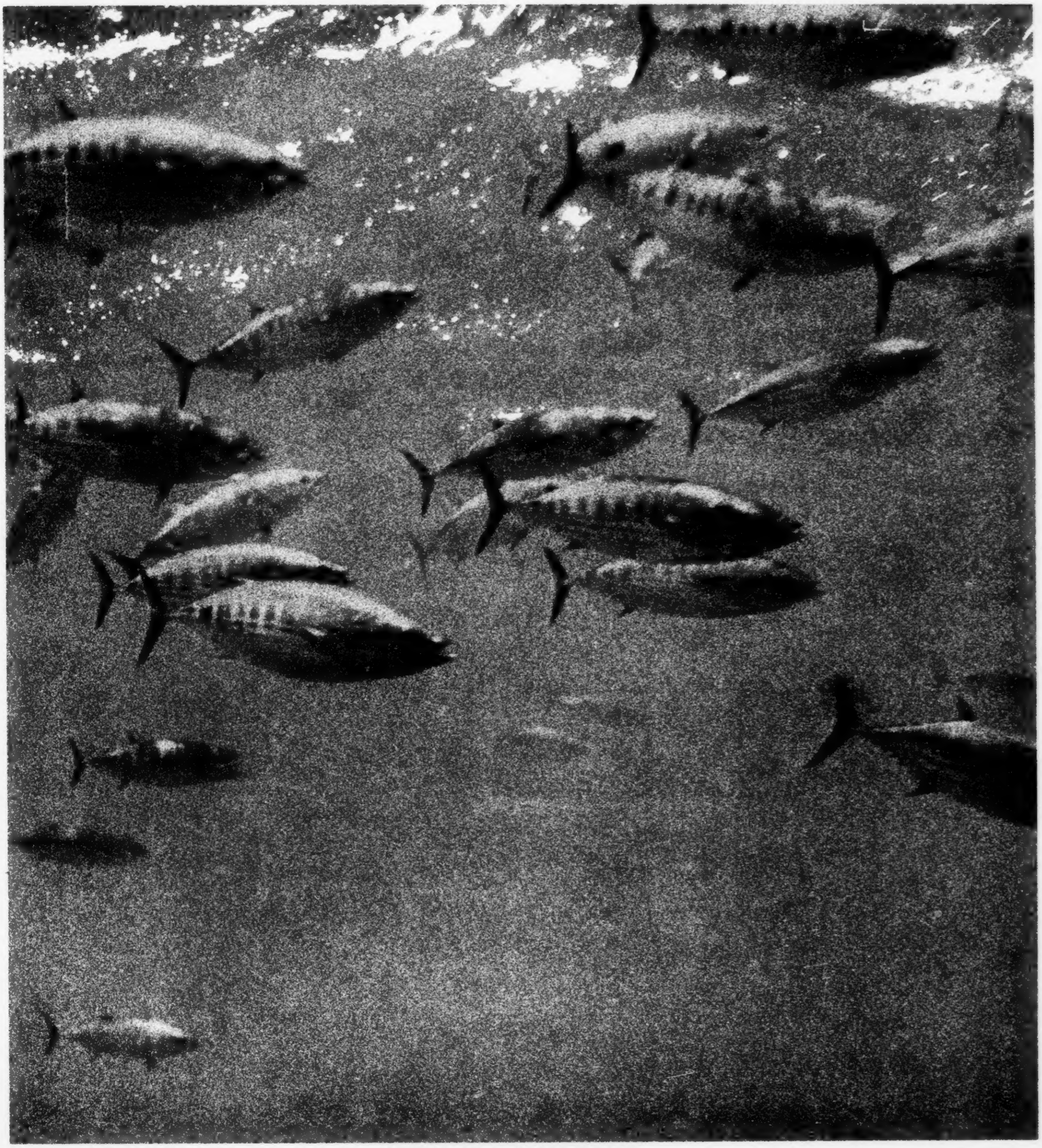

U.S. Canned Tuna

Marine Fisheries REVIEW

On the cover: School of skipjack tuna.

Articles

52(1), 1990

Competing for the Recreational Dollar: An Analysis of the California Commercial Passenger-Carrying Fishing Vessel Industry — *Christopher M. Dewees*, *Elizabeth M. Strange*, and *Greg Guagnano* 1

National Marine Fisheries Service Habitat Conservation Efforts in the Southeastern United States for 1988 — *Andreas Mager*, *Jr.* 7

U.S. Trade in Tuna for Canning, 1987 — *Wesley W. Parks*, *Patricia J. Donley*, and *Samuel F. Herrick*, *Jr.* 14

Departments

NOAA/NMFS Developments 23

Foreign Fishery Developments 25

Publications 36

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Competing for the Recreational Dollar: An Analysis of the California Commercial Passenger-Carrying Fishing Vessel Industry

CHRISTOPHER M. DEWEES, ELIZABETH M. STRANGE, and GREG GUAGNANO

Introduction

California has a large and diverse marine recreational fishery. Anglers on commercial passenger-carrying fishing vessels (CPFV's) harvest a substantial proportion of California's marine recreational fisheries landings, accounting for about 40 percent and 16 percent of the total 1986 marine recreational catch in southern and northern California, respectively (NMFS, 1987). In 1986, 459,369 CPFV anglers landed some 2,835,021 fish in southern California, while 200,925 CPFV anglers landed 1,240,100 fish in central and northern California[1].

In central and northern California's cold upwelled waters, traditionally targeted species include Pacific salmon, *Oncorhynchus* spp.; striped bass, *Morone saxatilis*; rockfishes, *Sebastes* spp.; lingcod, *Ophiodon elongatus*; and white sturgeon, *Acipenser transmontanus*. With the exception of the winter months, chinook salmon, *Oncorhynchus tshawtscha*, is the predominant target species. Several types of trips are offered to central and northern California anglers. One-day trips are offered for trolling or mooching for salmon (February-November), bottom fishing for rockfish and lingcod (all year), bait fishing for sturgeon in San Francisco Bay (winter), and live bait or trolling for albacore, *Thunnus alalunga*, in years when they migrate near shore in the late summer. When live anchovies, *Engraulis mordax*, are available from late spring through early fall, some San Francisco area vessels run one-day potluck trips targeting whatever is available that day. Striped bass, California halibut, *Paralichthys californicus*, chinook salmon and rockfish are the preferred target species.

In the subtropical waters off the urbanized southern California coast, pelagic species such as albacore; Pacific bonito, *Sarda chiliensis*; other tunas, *Thunnus* spp.; yellowtail, *Seriola lalandei*; Pacific barracuda, *Sphyraena argentea*; and Pacific or chub mackerel, *Scomber japonicus*, are traditional CPFV target species. Rockfishes and several basses (*Paralabrax* spp.) are important seasonally. In southern California, one-half to full day inshore freelance trips predominate throughout the year. These trips are analogous to northern California potluck trips except the target species are different (barracuda, bonito, basses, yellowtail, mackerel, rockfish, etc.). One-day trips targeting albacore (summer-fall) or rockfish (all year) are also available. Multi-day trips (2-3 days) are offered off California and northern Mexico targeting albacore, other tunas, and yellowtail. Long range trips up to 19 days long operate further offshore and south targeting tunas, yellowtail, and wahoo, *Acanthocybium solanderi*. The albacore, multiday, and long-range trips operate primarily out of San Diego.

In recent years, California's CPFV fleet has experienced an economic decline. In southern California, the fleet has decreased from 197 active vessels in 1963 (Young, 1969) to 170 in 1986[1]. Loads have also decreased from a total of 505,459 anglers in southern California in 1963 (Young, 1969) to a total of 459,369 anglers in 1986[1]. This occurred during a period of a 54 percent increase in California's population and a 38 percent increase in angling licenses (California Department of Finance, 1988:13, 135).

Declines are also apparent in the northern California fleet, which primarily operates from the San Francisco Bay Area and targets salmon. In 1963, 111 CPFV's were active in the Bay-Delta fleet, carrying 77,641 anglers (Young, 1969), but by 1986 the fleet had declined to 97 vessels carrying a total of 81,331 anglers[1]. Angler trips from San Francisco declined from the 1971-75 annual average of 102,500 to an annual average of 71,200 trips during 1983-87 (PFMC, 1988). Reasons commonly cited by CPFV owners for these declines include: Reduced fish abundance and availability, high costs, and competition with other recreational activities.

Little is known about California's CPFV industry or the characteristics, motivations, and perceptions of CPFV anglers. The only indepth review of the northern California CPFV industry (PFMC, 1978) addressed the salmon fishery. An historical review of the California recreational fishery (Smith, 1979) provides background on the development of gear and techniques. Several recent studies have begun to examine CPFV angler behavior (Andrews and Wilen, 1988) and California marine anglers' characteristics (NMFS, 1987). Several studies in other states provide concepts that can be applied in California to provide useful information to help the CPFV industry try to reverse its economic decline (Ditton, et al., 1978;

[1]California Department of Fish and Game. 1987. Tables of landings of California commercial passenger carrying fishing boat fleet. (Unpubl., tables provided by M. Oliphant, Commercial Passenger Fishing Vessel Project, Long Beach, Calif.)

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Dawson and Wilkins, 1980; Johnson and Griffith, 1985).

The objectives of this project were to: 1) Measure CPFV owners' and anglers' demographics, information sources, decision-making behavior, and perceptions and 2) recommend strategies for industry to improve and market their recreational product, based on survey results.

Methods

The data presented in this report were gathered from four separate and distinct sampling arenas. In both northern and southern California, one sample was drawn from CPFV anglers and another from the vessel owners. Due to difficulties with securing passenger lists from owners in both northern and southern California, slightly different procedures were used to survey anglers in each of these areas.

Angler Samples

In northern California, the angler sample was gathered from questionnaires distributed onboard San Francisco Bay Area CPFV's (Sausalito) during November 1987, May 1988, and July 1988. One weekend day and one weekday were sampled in each of these months. Anglers were asked to complete the questionnaire on the vessel's trip to the fishing grounds. This procedure resulted in 232 usable questionnaires.

In contrast to the procedure utilized in northern California, the sample of southern California anglers was gathered by mail questionnaire. The Sportfishing Association of California (SAC) assisted in supplying the names of 1,570 anglers who had fished with the southern California CPFV fleet. These questionnaires were mailed to 800 anglers selected randomly from the SAC list during the week of 31 March to 7 April 1987. In all, 364 (45.5 percent) of the questionnaires were returned and usable.

In a procedure similar to that employed for the southern California anglers, data for the northern and southern California vessel owner samples were gathered by mail survey. The northern California surveys were mailed directly to the 59 Golden Gate Fishermen's Association members in February 1987, while 235 southern California vessel owner surveys were included in the March 1987 newsletter of the Sportfishing Association of California. In all, the northern California procedure resulted in 22 (37.3 percent) returned and usable questionnaires, while the southern California procedure produced 54 (23 percent) returns.

The Questionnaires

The northern and southern California angler questionnaires were identical except for questions that demanded geographic specificity due to differences in fisheries. The nine-page survey instrument assessed the following:

1) Fishing and other recreational activities.
2) Sources of information about the CPFV industry.
3) Factors influencing the decision to go fishing on a CPFV.
4) Perceptions of the CPFV industry.
5) Demographic characteristics.

The surveys mailed to northern and southern California vessel owners differed only to reflect differences in fisheries. The 6-page questionnaires assessed the following:

1) Aspects of the respondent's business operation.
2) Perceptions of various fishes.
3) Perceptions of how clients view the CPFV industry.
4) Demographic characteristics.

All the survey instruments were pretested to perfect item wording, improve questionnaire flow and quality of response, and correct questionnaire length. In all, 45 questionnaires were pretested.

Results and Discussion

CPFV Owners

Characteristics of southern and northern California CPFV businesses are quite similar (Table 1), but southern California owners tend to be younger and have larger vessels. Larger vessels are needed for the multi-day trips and large passenger loads common in the southern California fishery.

While many vessels may specialize in one fishery, they may also switch into other fisheries seasonally (Table 2).

Table 1.—Characteristics of northern and southern California CPFV owners (mean values).

Characteristics	Southern (N=54)	Northern (N=22)
Length of vessel (feet)	66	50
Years in industry	20	20
Years of education	14	15
Age	41	50
Bookings as charters (%)	46%	46%

Table 2.—CPFV participation in major types of fisheries.

	Southern California (N=54)		Northern California (N=22)	
Fishery	No. of vessels	Mean no. of days	No. of vessels	Mean no. of days
Albacore	32	48	5	31
Rockfish	35	69	15	82
Inshore freelance	43	134		
Multi-day trips	24	23		
Long-range trips	9	68		
Salmon trolling			21	133
Potluck (striped bass, etc.)			4	19
Sturgeon			1	2
Nature trips			11	26

While the dominant fishery in northern California (Monterey Bay to Oregon border) is salmon trolling, many vessels target rockfish and schedule nature and whale watching trips during the winter months or during times of low salmon abundance. When live anchovies are available during the spring and fall months, some vessels run potluck trips targeting several types of fish on the same day such as striped bass, California halibut, rockfish, lingcod, and salmon.

In southern California (Morro Bay to San Diego), inshore freelance fishing is the primary fishery, supplemented with winter rockfish trips when pelagic species are less abundant. Albacore angling on 1-3 day trips depends on the species' annual and highly variable migrations (1987 and 1988 were extremely poor years). Several vessels specialize in long-range trips of 1-2 weeks in Mexican waters.

Vessel owners were asked for their ideas about improving their operations (Table 3) and attracting more customers (Table 4). Their suggested improvements focused on better customer service. Southern California owners frequently stated a need for better trained and more reliable

Table 3.—CPFV owners' suggestions for industry improvements.

Suggestions	Number mentioning	
	Southern California (N = 54)	Northern California (N = 22)
Increase services (crew, politeness, etc.)	25	7
Improve facilities (comfort, cleanliness, etc.)	15	7
Limit loads	6	2
Improve enforcement of regulations onboard	5	
Increase fish availability	5	
Improve onboard handling of fish	3	
Seasick pill that works		2

Table 4.—CPFV owners' ideas for attracting more customers.

Ideas	Number mentioning	
	Southern California (N = 54)	Northern California (N = 22)
Increase advertising and promotion	19	13
Improve fishing	7	8
Market recreational health benefits (relaxation)	9	
Lower cost of fares and licenses	8	3
Angler education (methods, utilization)	6	
Improve crews	5	
Improve vessels		3
Improve onboard handling of fish	2	

Table 5.—Employment status, income, ethnicity, and sex of California CPFV anglers (in percent).

Characteristics	Southern California	Northern California
Employment Status	(N = 362)	(N = 211)
Employed full-time	71	64
Employed part-time	3	4
Retired	25	32
Student	1	1
Unemployed	1	
Income (thousands)	(N = 354)	(N = 194)
<5		2
$5 to <10	1	1
10 to <20	5	9
20 to <30	12	16
30 to <40	18	19
40 to <50	17	17
50 to <60	15	14
>60	33	23
Ethnicity	(N = 357)	(N = 205)
Caucasian	90	82
Hispanic	1	6
Japanese	5	3
Chinese	1	2
Other Asian		2
Black	2	1
Native American		2
Other	2	2
Gender	(N = 363)	(N = 210)
Percent male	96	88

Table 6.—Selected characteristics of California CPFV anglers (mean values).

Characteristics	Southern California	Northern California
Age	51 (N = 357)	49 (N = 204)
Years of education	15 (N = 361)	14 (N = 215)
Years fishing	37 (N = 356)	16 (N = 216)

Table 7.—Days spent annually on recreational activities by California CPFV anglers.

Activity	Mean number of days	
	Southern California	Northern California
CPFV fishing	18	13
Backpacking	2	7
Skiing	2	4
Hunting	6	8
Boating	21	13
Freshwater fishing	13	18
Camping	12	10
Spectator sports	13	15
Team sports	9	11
Nature trips	4	5
Other salt-water fishing	18	5

deckhands who treat all customers politely. Improved facilities (seating, galleys, protection from weather) and cleanliness were often cited as needed improvements.

Most owners were concerned about the difficulty of attracting customers. Many cited a need for additional advertising and promotion. Nine southern California owners suggested that these promotions should emphasize the health benefits of a relaxing fishing trip away from the urbanized southern California environment. Some owners felt that improved fishing conditions would attract more customers and suggested pollution control as ways to increase resource abundance.

The idea of angler education was unique to the southern California owners and contains two thrusts: 1) Education about catching and utilization of underutilized species such as mackerel and 2) education to clarify mass media reports about the risks of eating southern California fish due to contamination by toxics. Finally, some CPFV owners' suggestion for lower fares is tempered by their concerns about increasing costs for moorage, insurance, maintenance, and the potential for a Federal marine angling license.

CPFV Anglers

Characteristics, Activities, and Information Sources

Anglers in these two samples tend to be well-educated Caucasian males with high incomes (Tables 5, 6). More than half earned at least $40,000 annually. A significant portion (25 percent) are retired people who may have more time available for recreation and represent a large potential market for CPFV's. The one striking difference between the two samples is the much greater fishing experience of the southern California anglers. This is probably due to the selection of the sample from the Sportfishing Association of California mailing list. Anglers on this list tend to be serious fishermen with a lifelong commitment to recreational angling[2].

[2]Bill Nott, President, Sportfishing Association of California. 1987. Personal commun.

Table 7 indicates that California's CPFV industry is competing with many other recreational industries for their customers. Other types of fishing, boating, and sports are the primary competition. Growth in these other forms of recreation in recent years may have contributed to some of the decline in the CPFV industry. The number of registered recreational vessels in California increased 80 percent between 1967 and 1988[3], increasing non-CPFV access to ocean fishing. Nationally, participation in many recreational activities (softball, golf, tennis, spectator sports) increased at a level equal or greater than population growth (USDOC, 1989:226-227).

The respondents' participation on CPFV's (Table 8) shows that the southern California fishery is more diverse but dominated by the inshore freelance fishery and that the salmon fishery attracts the most effort in the north. This difference is not unexpected because all of the northern California sampling was done on vessels trolling for salmon.

When asked to rank their sources of in-

[3]Compiled from U.S. Coast Guard *Boating Statistics* (1968-1988).

Table 8.—Mean number of days of angler participation in CPFV fisheries.

Fishery	Mean number of days	
	Southern California	Northern California
Inshore freelance	11	
Albacore	4	
Rockfish	4	3
Multi-day trips (2-3 days)	3	
Long-range trips (>3 days)	4	
Salmon trolling		11
Potluck (striped bass, etc.)		1
Sturgeon		1
Other (shark, billfish, etc.)	5	1

Table 9.—Anglers' most important sources of information about CPFV fishing.

Source	Number of anglers	
	Southern California	Northern California
Newspapers	112	17
Other fishermen	47	19
Magazines	38	3
Friends	36	68
Landing dock	31	3
Bait and tackle shops	19	12
Telephone call-in	8	2
Coworkers	2	15
Relatives	2	4
Cable and network TV	1	3
Radio	3	5
Tourist information		

Table 10.—Southern California anglers' perceptions of five types of CPFV fishing (percent agree[1]).

Item	Albacore	Rockfish	Inshore freelance	Multi-day (2-3 days)	Long-range (>3 days)
Compared to other types of outdoor recreation I participate in, this type of fishing is expensive	82	32	30	78	84
This type of fishing is relaxing and reduces stress	58	83	94	90	88
I enjoy this style of fishing (gear and techniques)	96	61	93	97	94
The boat is usually too crowded on these trips	79	61	82	41	30
The fish I catch are handled well onboard to preserve their eating quality	70	69	64	88	93
This type of fishing usually pays for itself in terms of the amount of fish taken home to eat	31	64	29	50	52
The bag limit (number of fish permitted) is too low in this fishery	9	21	16	13	12

[1]Includes both those who agree and those who strongly agree as measured on Likert scale: 1 = strongly agree, 2 = agree, 3 = disagree, 4 = strongly disagree.

Table 11.—Northern California anglers' perceptions of three types of CPFV fishing (percent agree[1]).

Item	Salmon trolling	Potluck	Rockfish
Compared to other types of outdoor recreation I participate in, this type of fishing is expensive	76	67	65
This type of fishing is relaxing and reduces stress	96	90	87
I enjoy this style of fishing (gear and techniques)	95	87	77
The boat is usually too crowded on these trips	41	55	55
The fish I catch are handled well onboard to preserve their eating quality	96	88	87
This type of fishing usually pays for itself in terms of amount of fish taken home to eat	51	48	66
The bag limit (number of fish permitted) is too low in this fishery)	44	38	35

[1]Includes both those who agree and those who strongly agree, as measured on Likert scale: 1 = strongly agree, 2 = agree, 3 = disagree, 4 = strongly disagree.

formation about CPFV fishing, southern California anglers often selected mass media such as newspapers and magazines[4] (Table 9). *Western Outdoors News* and the *Los Angeles Times* were relied on heavily. In contrast, northern California anglers most often ranked interpersonal sources such as friends, other fishermen, and coworkers as their most important information sources.

There are several possible reasons for this difference. Perhaps the more rural northern California environment facilitates interpersonal communication networks, while mass-media channels are more heavily utilized in urbanized southern California. Another likely explanation is that southern California newspapers regularly publish detailed daily catch reports that anglers use in making their decision to go fishing. Northern California newspapers generally publish weekly reports. It is also interesting that none of the respondents mentioned tourist information as an important source. This indicates either that the industry is not using this medium or that its use has little effect.

Angler Perceptions of CPFV Fishing

Anglers' perceptions of some attributes of CPFV fishing provide some useful insights (Tables 10, 11). With the exception of southern California rockfish and inshore freelance fishing, the majority of respondents consider CPFV fishing expensive compared to other outdoor recreation. This suggests that CPFV operators need to consider economic incentives such as reduced weekday and off-season rates to attract customers in the highly competitive outdoor recreation market. The inexpensiveness of southern California rockfish and inshore freelance fishing should be emphasized in CPFV marketing.

Almost all CPFV anglers find most fisheries to be relaxing and enjoyable. One exception is albacore fishing which involves intense competitive angling to capture the fish before they leave the vessel's area. Another exception is the rockfish fishery where very heavy sinkers (1-2 pounds) and gear are used to capture small fish (<5 pounds). CPFV operators might consider experimenting with light-tackle rockfish fishing to increase anglers' enjoyment.

Crowding is often mentioned as a nega-

[4]Mention of trade names or commercial firms or products does not imply endorsement by the National Marine Fisheries Service, NOAA.

tive attribute of CPFV fishing. This appears to be especially true in the albacore and inshore freelance fisheries. Offering limited loads at a higher price and providing incentives for going fishing at nonpeak times might help to lessen this negative perception.

The vast majority of anglers fishing in the cool northern California environment (50°-60°F air and water temperatures) or on long-range vessels equipped with refrigeration perceive that their fish are handled well onboard. However, about one-third of the respondents were not satisfied with onboard handling in the southern California albacore, rockfish, and inshore freelance fisheries. Warmer air temperatures (60°-90°F), water temperatures (60°-75°F) and the elevated body temperatures of pelagic fishes (bonito, mackerel, and albacore) can lead to rapid deterioration in eating quality. Because catching fish to eat is an important motivation for anglers (Matlock et al., 1988), improving onboard preservation techniques (e.g., refrigeration) could increase customer satisfaction. This may be especially critical for any expansion of inshore fisheries targeted at mackerel, bonito, and other pelagic species that tend to spoil rapidly (Dewees et al., 1988).

Most California anglers consider rockfish fishing cost-effective in terms of fish taken home to eat. Anglers seem willing to use heavy and more burdensome gear because of the food value of rockfish. Use of lightweight gear for rockfish might maximize both the food and angling attributes of this fishery in anglers' minds. During 1989 several northern California vessels began offering lightweight tackle trips for rockfish.

Only 29 percent of the respondents felt that inshore freelance fishing was cost-effective even though it is the least expensive fishing method. Although this perception could be due to the smaller size and numbers of fish captured, we feel that the primary reason could be the low esteem anglers have of many inshore fish as food fish. This is especially true for mackerel, bonito, and white croaker. Steps to improve the food quality (onboard refrigeration) and angler acceptance (education) of these species could increase angler satisfaction.

Table 12.—Anglers' most important consideration when deciding to go CPFV fishing.

Consideration	Number of anglers: Southern California	Number of anglers: Northern California
Reports of recent catches	80	36
Desire to get away and relax	62	26
Anticipation of catching fish	31	24
Time available	27	11
Fishing with friends/coworkers	25	34
Enjoying ocean environment	22	7
Anticipated weather conditions	17	3
Cost of fishing	11	6
Past experiences on similar trips	7	
Type of gear used	7	6
Time of year	6	
Fishing with relatives	5	8
Learning more about fishing	3	5
Other fishermens' opinions you respect	2	

In southern California, where most target species have no or high (10 fish) bag limits, few anglers felt that bag limits were too low. In northern California, 35-44 percent of the respondents felt that the bag limits were too low. In recent years the bag limits for salmon and striped bass have been reduced from three to two fish. Some anglers feel that these limits are too restrictive.

Angler Decisions

Table 12 summarizes the anglers' most important considerations which influence whether they will go CPFV fishing. There appear to be two groups of important considerations. One is related to catching fish (recent catch reports, anticipation of catches) (Andrews and Wilen, 1988) and the other is related to aesthetics (relaxation, environment, friends). This finding is consistent with past studies (Stevens, 1966; Dawson and Wilkins, 1981; Fedler, 1984; Andrews and Wilen, 1988). Finally, lack of time seems to be more of a barrier than cost.

CPFV owners are well aware of anglers' positive response to reports of recent good catches (Andrews and Wilen, 1988), but CPFV owners also commented that even when catch success is higher, loads are much lighter during nonsummer months than during summer. This problem is especially acute in northern California. Perhaps an increased effort to make daily catch reports widely available through mass media would attract more nonsummer customers.

Table 13.—Anglers' suggestions for CPFV improvements.

Suggestion	No. of anglers mentioning: Southern California (N = 364)	No. of anglers mentioning: Northern California (N = 232)
Limit loads	142	31
Improve Service		
Treat customers better	44	9
Better/more polite deckhands	29	6
Improved fish handling/ preservation	27	4
Rotate fishing spots	20	
Instruction for novices	17	3
Improve Facilities		
Toilets, bunks, seating, galley, etc.	53	19
Better bait	18	
Faster boats	9	
Don't let crew fish	20	
Limit gillnets/conservation concerns	16	9
Lower prices	12	
Less alcohol/drugs	7	3
More catch & release fishing	6	
Less littering	6	
Fine as is		55

CPFV owners should also consider incorporating the nonconsumptive attributes of CPFV fishing in their marketing efforts. Anglers rate relaxation, companionship, and enjoyment of the environment as important aspects of the CPFV experience.

Angler Suggestions for CPFV Improvements

When anglers were asked an open-ended question about how CPFV fishing could be improved (Table 13), northern California respondents appeared to be more satisfied (55 responded "fine as is"). This is probably because the smaller vessel size and smaller loads allowed for more personal service in northern California.

Overall, the suggestions focused primarily on lessening crowding, improving services, and improving facilities. Limiting loads is difficult because it often will necessitate raising prices. CPFV owners might consider limiting loads during the week or off-season to develop a steadier clientele during nonpeak periods. Offering lower prices at nonpeak periods may help to spread out customers over the year.

Improved service suggestions focus on better treatment of customers. In the

highly competitive recreation business, customers obviously want to be treated at least as well on fishing vessels as they are by other recreation businesses. De Young (1987) found the quality of service to be more important than catching fish in attracting repeat customers. Crew training and attention to customer satisfaction needs improvement.

Improved facilities are related to customer service. Respondents were particularly interested in cleanliness and improved seating. Comfort and convenience appears particularly important for the retired anglers who make up an important segment of CPFV clientele.

Recommendations

This survey of California CPFV owners and customers leads to the following comments and recommendations for the industry to consider if it wishes to reverse its gradual economic decline.

CPFV owners should continue to use the mass media to create awareness about CPFV fishing. Emphasize the nonconsumptive benefits of CPFV fishing as well as recent catch reports. In northern California the use of daily catch reports in newspapers and on radio should be considered.

Tourist information was not an important source used by anglers. This indicates either that the CPFV industry isn't utilizing this potential advertising opportunity, or that potential anglers don't read those materials. If they aren't currently doing so, CPFV owners might consider making tourists more aware of their service through tourist publications, travel agents, chambers of commerce, and joint marketing efforts with local tourist facilities (e.g., motels).

Friends and co-workers are important sources of information for northern California anglers. Increased use of interpersonal "relationship marketing" as described by De Young (1987) could increase customer loyalty and repeat business. This type of marketing emphasizes service, personal follow-up, and incentives for repeat customers.

Select crew members based on their ability and commitment to provide helpful, polite service to customers. Train the crew to work with the public.

Devise ways for limiting loads. Many anglers indicated a willingness to pay more for lighter loads. Provide incentives to encourage anglers to fish during the week or other periods when loads are light.

Provide good service to anglers, such as clean and comfortable facilities, fresh coffee, instruction for new anglers, information on care and use of the catch, information on the marine environment, opportunities for catch-and-release fishing, and improved onboard handling of the catch.

Consider limiting loads and using lighter tackle on rockfish trips. This may only be feasible on inshore shallow-water trips. Lighter gear may help improve anglers' perceptions of the fighting ability of rockfish to match their high appeal as food.

Provide onboard chilling of the catch, especially in southern California, with either refrigerated seawater or ice. Immediate chilling of fish such as mackerel, barracuda, and bonito should improve their quality significantly. This could lead to increased angler satisfaction and participation in the inshore freelance fishery.

Conduct research to determine why tourists and residents do or don't use CPFV's and how they could be attracted. Conduct research to determine how to target CPFV services at California's changing population, especially retirees and growing ethnic groups.

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National Marine Fisheries Service Habitat Conservation Efforts in the Southeastern United States for 1988

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ABSTRACT—Data quantifying the area of habitat affected by Federal programs that regulate development in coastal zones of the southeastern United States are provided for 1988. The National Marine Fisheries Service (NMFS) made recommendations on 3,935 proposals requiring Federal permits or licenses to alter wetlands. A survey of 977 of these activities revealed that 359,876 acres of wetlands that support fishery resources under NMFS purview were proposed for some type of alteration or manipulation. Almost 95 percent of this acreage was for impounding and/ or manipulation of water levels in Louisiana marshes. The NMFS did not object to alteration of 173,284 acres and recommended the conservation of 186,592 acres. To offset habitat losses, 1,827 acres of mitigation were recommended by the NMFS or proposed by applicants and/or the Corps of Engineers (COE). From 1981 to 1988 the NMFS has provided indepth analyses on 8,385 projects proposing the alteration of at least 656,377 acres of wetlands.

A follow-up survey on the disposition of 339 permits handled by the COE during 1988 revealed that the COE accepted NMFS recommendations on 68 percent. On a permit-by-permit basis, 13 percent of NMFS recommendations were partially accepted, 17 percent were completely rejected, and 2 percent were withdrawn. The permit requests tracked by the NMFS proposed the alteration of 2,674 acres of wetlands. The COE issued permits to alter 847 acres or 32 percent of the amount proposed.

Introduction

Since 1970, the National Marine Fisheries Service (NMFS) Southeast Region has been heavily involved in the review of development activities in wetland habitats that support marine, estuarine, and anadromous fishery resources. NMFS mandates to provide analyses and recommendations on activities that affect its trust resources are provided mainly under authority of the Fish and Wildlife Coordination Act. This Act requires that fish and wildlife interests be given equal consideration with other factors in Federal decisions on coastal development projects. These responsibilities, as they relate to living marine resources, are shared with the U.S. Fish and Wildlife Service (FWS) under Reorganization Plan Number 4 that placed the Interior Department's Bureau of Commercial Fisheries under the Department of Commerce's National Oceanic and Atmospheric Administration as the NMFS. Furthermore, the U.S. Court of Appeals ruled that the U.S. Army Corps of Engineers (COE) could deny a dredge and fill permit required by Section 10 of the River and Harbor Act of 1899 based on adverse effects to fish and wildlife and not just navigation alone (USCA, 1970). The Clean Water Act extended protection to wetlands above the mean high tide line.

The NMFS habitat conservation program in the southeast is largely geared toward involvement with proposals to alter coastal wetlands (fishery habitat). This process is described in detail by Lindall and Thayer (1982) and Mager and Thayer (1986). Simply put, fishery habitats are wetlands and other coastal habitats that provide food, cover, and other functions such as nursery or feeding grounds, and which are vital for the continued production of fishery resources (Smith et al., 1966; Douglas and Stroud, 1971; Turner, 1977; Peters et al., 1979; Thayer and Ustach, 1981). Wetlands also provide many other benefits such as erosion protection, a buffer against storms, production of wildlife other than fish, water quality maintenance, aesthetics, and recreation.

Each year the COE receives thousands of requests for permits to alter wetlands. In addition, many projects are proposed by the COE under their own civil works program. Alterations range from construction of docks or other minor structures to massive dredge, fill, and impoundment projects. These activities can result in considerable destruction of fishery habitat if implemented. However, under the legislation discussed earlier, the COE is required to consult with the fish and wildlife agencies and provide detailed plans and specification for their review and comment. The comments of the fish and wildlife agencies are considered in the COE's determination on whether a project should be authorized, modified, or denied; but the final decision rests with the COE.

Although NMFS recommendations to the COE are designed to minimize adverse project impacts on fishery resources, in the 1970's, these recommendations generally had a minimal effect on wetlands conservation. The COE granted most of the permits to alter wetlands without including in them the recommendations of the NMFS. The importance of coastal wetlands to fishery production was not well understood or documented and the "opinions" of the NMFS were not able to compete well with reported benefits of the projects (mostly economics) in the COE's public interest review. Moreover, habitat losses involved in the various regulatory programs were often considered insignificant, even though the

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amount (i.e., cumulative effect), type, and geographical distribution of the altered habitat was generally unknown.

To improve the acceptance of its recommendations, the NMFS began to compile information showing the quantity of alterations involved and the significance of the Federal regulatory and construction programs. Another important purpose of the program was to determine the effectiveness of NMFS recommendations. This information helps to determine the cumulative amount of habitat alterations regulated by the COE and others so that more convincing arguments can be made to prevent avoidable damage to wetlands and fisheries production. It also allows the effectiveness of the habitat conservation program to be monitored so necessary modifications can be made. The NMFS Southeast Fisheries Center also has conducted much research which better explains and documents the importance of wetlands to fishery production. More recent research also is addressing mitigation options such as creation and/or enhancement of wetlands.

This paper presents the results of the NMFS' 1988 habitat conservation efforts related mostly to COE permit and civil works programs. The information we provide covers mainly the coastal wetlands in the NMFS Southeast Region (North Carolina to Florida to Texas plus Puerto Rico and the U.S. Virgin Islands). These data build on the detailed habitat information on 7,408 of the approximate 32,000 projects reviewed by the NMFS Habitat Conservation Division in the southeastern United States between 1981 and 1987. During this period, more than 300,000 acres of wetlands were proposed for alteration (Mager and Ruebsamen, 1988). This is alarming in view of the coastal wetland loss rate in the United States estimated by Alexander et al. (1986) at 20,000 acres per year for the last 25 years. This amount does not include losses of submerged aquatic plants about which there is little information. The rate of marshland loss in the southeast, for example in Louisiana, is likely even greater.

Materials and Methods

For each proposed habitat alteration under Federal purview, information was recorded to allow NMFS retrieval by project identification number; location by state, county, and proximity to major and secondary waterbodies; and dates such as public notice date and when responded. Data also include the kind of activity involved (e.g., permit application, Federal project, etc.); the type of project being reviewed (e.g., bulkhead, dock, maintenance dredging, navigation channel, marsh management, power plant, housing development, etc.); and whether the NMFS objected to, recommended modifications of, or approved the activity. The procedure is detailed in Lindall and Thayer (1982), Mager and Thayer (1986), and Mager and Keppner (1987).

The NMFS also tracked the impact in acres of wetlands potentially affected by a given proposed activity. The acreage values presented for projects surveyed during 1988 were obtained from onsite reviews by NMFS contractors or NMFS biologists, from public notices, and from project plans that were adequate to determine the acreage and habitat types proposed for alteration. The NMFS tracked individual actions by the amount of potential impact (i.e., dredge, fill, drain, impound); the amount of habitat modification the NMFS accepts or does not object to; and the amount of habitat potentially conserved.

The NMFS also surveyed project permits approving construction in wetlands that were issued by the COE. Those projects on which we 1) were notified by the COE that a permit has been issued, 2) had accurate information on the area and kind of wetlands requested for alteration, and 3) could determine the area of alteration that the COE actually permitted, were logged on a computer. The NMFS also recorded COE acceptance, partial acceptance, or rejection of its recommendations.

Results

The NMFS evaluated and responded to 3,935 proposals for construction in wetlands in the southeastern coastal states during 1988. Most of the actions (3,417) involved evaluation of projects advertised by the COE pursuant to the River and Harbor Act and/or the Clean Water Act. The NMFS also reviewed 46 proposed Federal civil works projects such as major navigation and maintenance dredging (under authority of the Fish and Wildlife Coordination Act), 42 proposals to construct bridges and/or causeways under the jurisdiction of the U.S. Coast Guard, and 430 projects that illegally altered wetlands. For the projects reviewed, 2,604 (66 percent) received a "no objection" response because impacts on fishery habitat were minimal, impacts were offset by appropriate mitigation, or the projects were inland and were not used by fishery resources under NMFS purview. In-depth review was given to 714 (18 percent) of the projects because of probable direct or cumulative adverse effects to fishery resources. For 616 projects (16 percent) we coordinated with other agencies such as the FWS and the Environmental Protection Agency (EPA) because their resources and interests were affected to an equal or greater extent than ours or because of limited manpower. Only one project was not evaluated because it was offshore where the COE does not accept recommendations other than those pertaining to navigation or national defense.

NMFS habitat conservation efforts relating to a sample of the projects reviewed during 1988 are discussed below by state, the type of proposed alteration (i.e., dredge, fill, other), the area of alteration proposed by applicants and accepted and potentially conserved by the NMFS, the types and amounts of wetlands involved, the types of projects encountered (marinas, impoundments, etc.), the Federal programs that regulate wetland alterations (e.g., Section 10, 404, etc.), cumulative totals, and how NMFS comments and recommendations were treated.

Dredging

Approximately 4,011 acres of wetlands were proposed for dredging by the 977 projects surveyed (Table 1, column 2). Most of the dredging was proposed in North Carolina and Texas (30 percent each), Louisiana (18 percent), Georgia (8 percent), Florida (6 percent), and South Carolina (4 percent). The remaining 2 percent was proposed in Alabama, Mississippi, Puerto Rico, and the U.S. Virgin Islands. More than 75 percent of the pro-

posed dredging was to maintain existing channels and boat basins. The NMFS opposed the dredging of 1,684 acres because habitats important to fisheries resources would be altered (Table 1, column 8), but accepted the dredging of 2,327 acres because effects on fishery resources were determined to be minimal and only short-term (Table 1, column 5).

Most of the area potentially conserved involved mainly one project in Galveston Bay, Tex., where a wider and deeper channel from the mouth of the Bay to Houston (Houston Ship Channel) is proposed by the COE. There is extensive opposition to the proposed work, but the COE has not yet advised the NMFS whether or not they still will seek authorization for construction. Of the remaining area potentially conserved, 13 percent was in Louisiana, 9 percent in Georgia, and 6 percent in Florida. About 11 percent was scattered in the remaining states.

Filling

About 14,632 acres of wetlands were proposed for filling (Table 1, column 3). More than 78 percent was in Texas, followed by Louisiana (11 percent), Florida (6 percent), and North Carolina (4 percent). The NMFS did not oppose the filling of 2,092 acres (Table 1, column 6). Most of this latter amount was in Louisiana (59 percent), North Carolina (21 percent), Florida (11 percent), and Georgia (6 percent). Potential acreage conserved was 12,540 acres (Table 1, column 9), but more than 11,000 acres of this amount involves filling associated with the Houston Ship Channel project. Such projects may have a large impact on our habitat conservation program in any given year because of their size, complexity, and the length of time required for resolution.

Other Impacts

This category is used as a catch-all, but most activities recorded here involve impounding and draining of wetlands. Approximately 341,233 acres were proposed to be altered (Table 1, column 4). Most of this acreage was in Louisiana and involved four separate applications by a major corporate landowner. These applications proposed the maintenance of 214 earthen plugs, 373 fixed crest weirs, and three gated water control structures for water level and marsh management purposes. After extensive review of research information and 1985 color infrared aerial photographs, NMFS biologists concluded that maintenance of about 10 percent of the plugs and 30 percent of the weirs, would potentially unacceptably impact migrations of fish and invertebrates and habitat quality in about 155,000 acres of wetlands. This conclusion was formed because the wetlands at the sites had continued to deteriorate despite management.

The NMFS also did not find any evidence of plugs or structures that required maintenance. It further appeared that existing structures were causing marsh loss through impoundment, fishery migratory patterns were being disrupted, and that, in the case of the gated structures, no management plan was proposed. The NMFS recommended these individual sites not be authorized, but rather that they be assessed separately at the time maintenance on each is proposed to allow a more detailed evaluation.

Many of the remaining plugs and structures affecting an estimated 168,300 acres of coastal wetlands had been maintained since the 1950's. The NMFS did not object to the continued maintenance of these structures because they were located in areas of low value to living marine resources, the marsh habitats influenced by the structures did not appear adversely impacted, and structures and plugs were well maintained and functional. Removal of the existing functional plugs and weirs also could have resulted in greater ecological damage. Access by fish and shellfish was being maintained to some extent, but removal of structures could have increased marsh loss by erosion and through altered hydrology and changes in salinity patterns.

Mitigation

The NMFS recommended 1,827 acres of mitigation (Table 1, column 11). Most mitigation acreage was in Louisiana (76 percent), followed by Georgia and North Carolina (6 percent each), Florida (5 per-

Table 1.—NMFS southeastern United States 1988 habitat conservation efforts by state.

		Acreage proposed for alteration			Acreage accepted by NMFS			Potential acreage conserved			Recommended mitigation
State	N[1] (1)[3]	Dredge (2)	Fill (3)	Other[2] (4)	Dredge (5)	Fill (6)	Other (7)	Dredge (8)	Fill (9)	Other (10)	Acres (11)
Alabama	20	52.5	9.5	0.0	5.3	2.9	0.0	47.2	6.6	0.0	2.6
Florida	306	225.4	845.1	12.0	122.7	225.7	1.3	102.7	619.4	10.7	94.2
Georgia	63	342.8	179.4	0.0	186.9	117.7	0.0	155.9	61.7	0.0	112.1
Louisiana	93	737.0	1,548.8	340,305.1	512.6	1,239.0	168,800.0	224.4	309.8	171,505.1	1,393.1
Mississippi	8	27.5	6.5	0.0	2.1	0.1	0.0	25.4	6.4	0.0	18.0
N. Carolina	281	1,220.8	508.5	666.8	1,183.5	437.7	50.9	37.3	70.8	615.9	105.8
Puerto Rico	3	11.8	1.5	0.0	0.0	0.0	0.0	11.8	1.5	0.0	0.0
S. Carolina	126	174.3	103.7	161.5	109.0	46.5	0.2	65.3	57.2	161.3	29.9
Texas	75	1,217.8	11,425.6	87.2	204.7	22.1	13.0	1,013.1	11,403.5	74.1	71.4
Virgin Islands	2	1.4	3.2	0.0	0.0	0.1	0.0	1.3	3.2	0.0	0.0
Total	997	4,011.3	14,631.8	341,232.6	2,326.8	2,091.8	168,865.4	1,684.4	12,540.1	172,367.2	1,827.1

[1]N refers to the number of projects for which acreage data could be obtained.
[2]This impact category is a catchall, but the acreage presented includes mainly marsh management projects, impoundments, and wetland drainage works.
[3]Numbers in parentheses refer to columns discussed in the text.

Table 2.—Acres of habitat proposed for alteration by ecological system[1].

Habitat type	Ecological system			
	Estuarine			
	Subtital	Intertidal		
Aquatic bed	129.7	0.3		
Flat	47.4	118.2		
Reef	0.0	0.9		
Unc. bottom[2]	181,165.3	2.5		
Beach/bar	0.0	1.2		
Emergent	0.0	173,738.2		
Forested	0.0	118.3		
Streambed	0.0	3.0		
Scrub/shrub	0.0	6.5		
Total	181,342.4	173,989.1		
	Marine			
	Subtidal	Intertidal		
Aquatic bed	4.1	0.0		
Unc. bottom	152.4	0.0		
Beach/bar	0.0	2.5		
Flat	0.0	1.1		
Total	156.5	3.6		
	Palustrine			
Emergent	2,168.0			
Forested	1,662.0			
Scrub/shrub	105.6			
Total	3,935.6			
	Lacustrine			
	Limnetic	Littoral		
Open water	0.8	22.0		
Emergent	0.0	2.6		
Unc. bottom	0.0	1.0		
Total	0.8	25.6		
	Riverine			
	Tidal	Lower perennial	Upper perennial	Inter-mittent
Emergent	45.7	0.0	0.0	0.2
Unc. bottom	306.5	66.2	2.3	0.0
Streambed	0.0	0.0	0.0	1.2
Total	352.2	66.2	2.3	1.4

[1]Follows the Cowardin et al. (1979) wetlands classification system.
[2]Unconsolidated bottom.

Table 3.—Acres[1] of habitat alterations proposed during 1988 by vegetation or substrate type.

Dominant habitat	Acres proposed for alteration	Acres accepted by NMFS	Acres potentially conserved	Acres recommended for mitigation
Algae	1.1	0.4	0.7	0.1
Black mangrove	38.4	6.8	31.6	0.5
Black needlerush	153.8	18.1	135.7	4.0
Eelgrass	1.3	0.0	1.3	0.0
Freshwater marsh	2,301.0	121.7	2,179.3	38.5
Freshwater submerged aquatic vegetation	4.5	1.4	3.1	0.0
Hardwood swamp	1,767.1	519.4	1,247.7	191.6
Manatee grass	0.2	0.0	0.2	0.0
Miscellaneous	1.8	1.8	0.0	1.7
Mud	179,832.2	86,496.4	93,335.8	59.3
Other marsh	159,240.7	84,101.2	75,139.5	62.9
Oyster reef	0.9	0.0	0.9	0.0
Red mangrove	44.9	0.6	44.3	0.7
Saltgrass	1,744.3	10.8	1,733.5	2.6
Saltmeadow cordgrass	12,238.3	47.8	12,190.5	1,240.4
Sand	1,728.6	1,591.5	137.1	3.2
Shoalgrass	30.4	17.2	13.2	51.0
Shell	0.0	0.0	0.0	0.3
Silt	305.8	272.0	33.8	0.0
Smooth cordgrass	299.8	55.0	244.8	150.2
Threecorner grass	5.7	4.5	1.2	0.0
Turtlegrass	1.7	0.1	1.6	2.8
White mangrove	39.1	5.8	33.3	10.8
Wigeon grass	94.1	11.5	82.6	6.5
Total	359,875.7	173,284.0	186,591.7	1,827.1

[1]Acreages are based on a sample of 977 projects.

cent), and Texas (4 percent). Less than 3 percent occurred in the remaining states. The mitigation area is less than in previous years reflecting the agency's concerns that many mitigation projects proposed in the past have not been successful (Race, 1982, 1985) or require a long time to replace the function of the wetland that was altered (Craft et al., 1988). Accordingly, the main goal of the NMFS is to ensure that a net loss of fishery habitat does not occur. Thus, alternatives are first sought that avoid or minimize damage. For nonwater-dependent projects, wetland alterations are usually opposed since the projects' purpose does not require location in wetlands.

Where a project is water-dependent and where losses of habitat are clearly unavoidable, the NMFS may recommend that such losses be mitigated to the maximum extent practicable (Lindall et al., 1979). The acceptability of a mitigation proposal relates to its potential to restore the functional values of the wetlands to be altered. Accordingly, the NMFS is very conservative in its acceptance of mitigation proposals unless all measures to avoid adverse impacts have been implemented and it is likely that wetland compensation efforts would replace fishery production.

Types of Habitat Proposed for Alteration

More than 98 percent of all alterations (355,332 acres) were proposed in estuarine systems (Table 2). Estuarine subtidal habitats, mostly unconsolidated bottoms, comprised 51 percent of the total. Estuarine intertidal habitat comprised 49 percent of the total; almost all of this was emergent wetlands. Smaller amounts of wetland alterations also were proposed in marine (160 acres), palustrine (3,936 acres), lacustrine (26 acres), and riverine (422 acres) ecological systems. For the five ecological systems, unconsolidated bottoms and emergent wetlands comprised 50 percent and 48 percent, respectively, of all the wetlands proposed for alteration.

Most of the unconsolidated bottoms (179,832 acres) were composed of mud, while most of the emergent marsh (159,241 acres under "other marsh" in Table 3) could not be separated into dominant vegetation types. Considerable amounts of saltmeadow cordgrass, *Spartina patens*, (12,238 acres); freshwater marsh (2,301 acres); hardwood swamps (1,767 acres); and saltgrass, *Distichlis spicata*, (1,744 acres) were proposed for alteration (Table 3).

Area Regulated by Federal Programs

Almost all of the proposed fishery habitat alterations reviewed by the NMFS in

the southeast were under the direct control of the COE. From a sample of 977 projects reviewed by NMFS, about 359,876 acres, or 95 percent of the total area of habitat alterations, were involved in the COE's regulatory program and about 4 percent (14,929 acres) were involved in their civil works program (Table 4). The remaining alterations tracked resulted from U.S. Coast Guard bridge permit requests and unauthorized wetland alteration projects.

Area Potentially Impacted by Type of Project

The projects reviewed included 803 proposals for docks and other minor structures; 646 shoreline altering works such as bulkheads, small fills, groins, and/or ramps; 544 residential housing developments; 391 maintenance dredging projects; 244 oil and gas exploration activities; 241 navigation channels and marinas; 232 bridges and causeways; 192 industrial and commercial developments; 162 miscellaneous activities; 154 water, gas, and/or chemical pipelines; 153 barriers, dams, and/or impoundments; 70 sand, gravel, and other mining operations; 40 electrical transmission lines; 31 irrigation projects; 18 marsh management activities; and 14 beach nourishment projects.

About 95 percent (340,315 acres) of the proposed habitat alterations, 97 percent (168,905 acres) of the alterations accepted by the NMFS, and 92 percent (171,411 acres) of the wetlands area potentially conserved resulted from requests to manage marshes (Table 5). This activity and its significance were detailed above. Almost 13,000 acres of navigation works were proposed, but more than 98 percent of the impacted area was associated with open water disposal of dredged material from proposed new COE Federal navigation channels and deepening and widening of existing channels. Maintenance dredging accounted for 3,208 acres of the alterations reported. Since we believed this would have produced only minor disturbance of fishery habitat, the NMFS accepted most of the acreage proposed (3,010 acres). Material disposal from maintenance dredging was proposed for 1,393 acres of bay bottom, but 1,009 acres were included in wetland mitigation efforts.

Table 4.—Acres of habitat proposed by applicants and reviewed by NMFS under the various Federal regulatory programs.

Project kind[1]	N[2]	Acres proposed by applicants	Acres accepted by NMFS	Potential acres conserved	Mitigation recommended
10	141	621.5	547.1	74.4	140.3
10/404	519	342,356.1	169,682.0	172,674.1	385.5
404	178	1,744.4	370.9	1,373.5	196.0
CFP	23	14,928.8	2,635.1	12,293.7	983.2
CG	8	18.2	17.1	1.1	21.0
I10	11	4.8	2.2	2.6	0.3
I10/104	40	39.3	22.8	16.5	57.6
I404	57	162.6	6.8	155.8	43.2
Total	977	359,875.7	173,284.0	186,591.7	1,827.1

[1] 10 = projects requested pursuant to Section 10 of the River and Harbor Act; 404 = projects requested pursuant to the Clean Water Act; 10/404 = projects advertised under Section 10 and 404 authorities; CFP = Corps Federal Project; CG = U.S. Coast Guard bridge/causeway permit application; I10, I404, and I10/404 = unauthorized projects.
[2] N represents the number of projects of each type sampled.

Cumulative Totals

Overall, nearly 359,876 acres of wetlands were proposed for alteration during 1988. The NMFS did not object to the alteration of 173,284 acres and 186,592 acres could be conserved if NMFS recommendations are accepted by the regulatory agencies. The NMFS also recommended restoration, generation, and enhancement of at least 1,827 acres to mitigate for adverse project impacts.

The NMFS did not oppose the alteration of 168,900 acres of wetlands proposed for continued hydrologic management in Louisiana; 3,028 acres of maintenance dredging and dredged material disposal in silt, mud, and sand substrate; and about 643 acres of freshwater wetlands where NMFS trust resources were not affected. Of the 173,284 acres of wetland alterations the NMFS did not oppose, an estimated 171,970 acres of alterations would have minimally impacted marine, estuarine, or anadromous fishery resources. The remaining 1,314 acres of alterations were offset by 1,827 acres of mitigation (a ratio of 1.4:1). Specifically, 1,763 acres of the mitigation requested was for vegetated wetlands, including more than 60 acres of submerged aquatic vegetation.

Between 1981 and 1987 more than 296,501 acres of wetlands were proposed for alteration by 7,408 water development projects (Mager and Ruebsamen, 1988). The addition of 1988 data brings the total area proposed for alterations to 656,377 acres by 8,385 water development projects (Table 6). The amount of wetlands accepted for alteration by the NMFS, the amount potentially conserved,

Table 5.—Acres of habitat alterations requested by applicants and reviewed by NMFS for various types of projects reviewed during 1988.

Project type[1]	N[2]	Acres proposed by applicants	Acres accepted by NMFS	Potential acreage conserved	Mitigation recommended
BA	37	1,066.7	67.7	999.0	43.4
BE	4	50.0	50.0	0.0	0.0
BR	94	234.6	167.3	67.3	141.1
DO	13	1.5	0.2	1.3	0.0
HO	203	725.5	119.4	606.1	33.9
IN	71	378.6	94.7	283.9	57.0
IR	10	107.9	34.5	73.4	80.0
MD	101	3,028.1	3,010.1	18.0	1,009.3
MI	4	110.2	79.2	31.0	1.1
MM	12	340,315.4	168,904.6	171,410.8	100.0
NA	110	12,876.1	311.1	12,565.0	70.7
OI	37	521.1	277.9	243.2	143.6
OT	26	81.8	32.5	49.3	54.3
PI	25	76.0	72.6	3.4	69.8
SH	226	301.5	61.5	240.0	22.3
TR	4	0.7	0.7	0.0	0.6
Total	977	359,875.7	173,284.0	186,591.7	1,827.1

[1] (BA) barriers and impoundments; (BE) beach nourishment projects; (BR) bridges, roads, and causeways; (DO) docks and other minor structures; (HO) housing development; (IN) commercial and industrial development, etc.; (IR) irrigation and drainage works; (MD) maintenance dredging; (MI) mining and mineral exploration; (MM) marsh management areas; (NA) navigation projects, marinas, etc.; (OI) oil and gas construction; (OT) unclassified; (PI) oil, gas, and chemical pipelines; (SH) bulkheads, small fills, groins, etc.; (TR) transmission lines.
[2] N refers to the number of projects where data is available on the area of proposed alteration.

Table 6.—NMFS southeastern United States habitat conservation efforts from 1981 to 1988.

Year	N[1]	Acres proposed for alteration	Acres accepted by NMFS	Acres potentially conserved	Acres gation mitigated
1981	811	7,949	2,868	5,081	2,471
1982	1,059	81,184	21,831	59,353	7,910
1983	825	20,778	8,658	12,120	26,775
1984	888	8,606	3,981	4,625	54,050
1985	1,802	65,670	11,161	54,509	19,200
1986	969	90,559	70,838	19,721	49,713
1987	1,054	21,755	8,135	13,620	7,139
1988	977	359,876	173,284	186,592	1,827
Total	8,385	656,377	300,756	355,621	169,085

[1] N refers to the number of projects sampled.

and the amount potentially mitigated total 300,756, 355,621, and 169,085 acres, respectively, for the 8 years we have collected data.

Effect of NMFS Recommendations

NMFS effectiveness was determined from a survey of 339 issued permits for which information had been provided by the COE to allow an assessment on whether or not NMFS comments and recommendations had been accepted (Table 7). The overall acceptance of NMFS recommendations by the COE was about 68 percent. NMFS recommendations were partially accepted and completely rejected on 13 percent and 17 percent of the reviews, respectively. The district with the highest acceptance of NMFS recommendations was the Wilmington District (96 percent, followed by the Charleston District (76 percent), Galveston District (64 percent), Mobile District (58 percent), Savannah District (56 percent), New Orleans District (44 percent), and the Jacksonville District (29 percent). Seven of the permit requests were withdrawn by the applicants.

The amount of habitat permitted for alteration by the COE and accepted by the NMFS was determined by COE district for 332 authorizing documents that were evaluated. Copies of the issued permits detailing what was permitted by the COE and previously obtained NMFS data on the area proposed for alteration allowed this analysis. More than 2,673 acres of wetlands were proposed for alteration by the 332 projects (Table 8). The NMFS did not oppose the alteration of 625 acres (23 percent of the amount proposed), thereby asking that 2,049 acres be conserved. The COE, however, permitted 32 percent of the area proposed for alteration by applicants (847 acres) or 8 percent more than recommended by NMFS. The COE permitted 79 percent of the 515 acres of mitigation recommended by the NMFS or proposed by applicants.

Table 7.—Treatment of NMFS recommendations on permits issued by Corps of Engineers District (COE).

COE District	N[1]	NMFS recommendations accepted		NMFS recommendations partially Naccepted		NMFS recommendations rejected		Applications withdrawn	
Charleston	32	25	(78.2)[2]	1	(3.1)	5	(15.6)	1	(3.1)
Galveston	38	24	(63.2)	7	(18.4)	4	(10.5)	3	(7.9)
Jacksonville	73	21	(28.8)	25	(34.2)	27	(37.0)	0	(0.0)
Mobile	12	7	(58.4)	1	(8.3)	4	(33.3)	0	(0.0)
New Orleans	34	15	(44.1)	10	(29.4)	8	(23.5)	1	(3.0)
Savannah	12	6	(50.0)	1	(8.3)	3	(25.0)	2	(16.7)
Wilmington	138	133	(96.4)	0	(0.0)	5	(3.6)	0	(0.0)
Totals	339	231	(68.1)	45	(13.3)	56	(16.5)	7	(2.1)

[1]N refers to number of projects sampled.
[2]Values in parentheses represent percent of N for each category.

Table 8.—Acres of habitat permitted for alteration over NMFS objections.

COE District	N[1]	Acreage proposed by applicants	Acreage NMFS accepted or did not object to		Acreage COE permitted		Percent[2] differ-ence	Acreage NMFS recommended mitigation	Acreage COE permitted mitigation
Charleston	31	250.5	11.1	(4.4)[3]	59.2	(23.6)	(19.2)	1.0	0.8
Galveston	35	112.7	66.2	(58.7)	90.8	(80.6)	(21.9)	56.3	62.4
Jacksonville	73	168.0	102.2	(60.8)	149.9	(89.2)	(28.4)	50.6	33.1
Mobile	12	192.2	137.2	(71.4)	190.7	(99.2)	(27.8)	161.3	145.6
New Orleans	33	1,254.9	172.6	(13.8)	219.2	(17.5)	(3.7)	183.2	94.3
Savannah	10	63.4	62.6	(98.6)	62.9	(99.1)	(0.5)	54.7	54.7
Wilmington	138	631.9	73.3	(11.6)	74.1	(11.7)	(0.1)	8.0	14.0
Totals	332	2,673.6	625.2	(23.4)	846.8	(31.7)	(8.3)	515.1	404.9

[1]N refers to the number of projects samples.
[2]This column is the percent of habitat alterations accepted by the NMFS subtracted from the percent permitted by the COE.
[3]Numbers in parentheses refer to percent of the acreage proposed.

Discussion

The area of proposed habitat alterations reported herein are very conservative. Not all alterations were evaluated because of the large number of activities the NMFS is involved with and the lack of manpower to allow a greater amount of follow-up. For example, NMFS biologists attend many pre-application meetings at which projects are modified to reduce their impact on wetlands before the applicant requests a permit from the COE. Therefore, many of these projects result in minimal environmental impact. Many of the habitat losses tracked also may be small, yet have a large adverse impact that is not reflected by the area of proposed alterations that are reported. Examples include fill deposits which alter hydrologic patterns within estuaries, create barriers that block access to marine organisms, and alter sediment and freshwater inflow needed to nourish the marshes and maintain salinity gradients.

The area of proposed habitat alterations reported represents only the wetlands and other coastal areas which support fishery resources under the purview of the NMFS. Lacustrine, palustrine, and riverine wetlands that do not support marine, estuarine, or anadromous fishery resources generally are not included in our data base. The FWS, the EPA, and state and local wetland conservation agencies also may have overlapping programs that involve an additional, but usually unquantified wetland acreage. Also, many nationwide and general permits now exist which give blanket authorization to thousands of projects each year that we are unable to monitor.

Discussions are currently underway among a number of Federal and state environmental and regulatory agencies on a "no net loss of wetland" concept proposed by U.S. President George Bush. Methods to achieve this goal are being discussed at various levels and

efforts to define the concept are underway. The NMFS habitat program in the southeast has evolved to focus available resources where the best chances for minimizing habitat losses can be achieved. The approach we have taken, i.e., priority given to involvement with the civil works and regulatory programs of the COE, is based on NMFS data which demonstrates that 99 percent of the potential habitat alterations tracked falls under these programs. If the NMFS recommendations would be fully incorporated, the loss of wetlands supporting resources under NMFS purview can be reduced to levels approaching the goal of no net loss, at least for those habitat losses that can be regulated.

Conclusions

Data collected by the NMFS document the significance of the Federal regulatory and construction programs in managing human induced wetland alterations in the southeast. The NMFS is only partially effective in getting its conservation recommendations included in approved water-development projects. However, the amount of habitat potentially conserved and permitted demonstrates the importance of the NMFS involvement.

In view of the cumulatively large area of wetlands which could be altered through the COE regulatory and civil works programs, we believe there is ample justification for some COE districts to increase the rate at which they accept and incorporate the NMFS and other resource agency recommendations in the public interest review process. This would be a positive step toward minimizing habitat losses that can be directly controlled by man and would especially be necessary to reach a goal of no further wetland loss.

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U.S. Trade in Tuna for Canning, 1987

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ABSTRACT—U.S. tuna fleet activity, canned tuna processing, ex-vessel, wholesale and retail prices and imports in 1987 are described and compared to their counterparts in previous years. Industry statistics gathered from government agencies and industry contacts are presented in 14 figures and 8 tables.

In 1987, U.S. tuna fisheries delivered 253,936 short tons (tons) of tuna to U.S. canneries. Domestic deliveries of albacore (white-meat) tuna were 2,836 tons, down 20 percent from 1986 levels. Domestic deliveries of tropical (light-meat) tuna (bigeye, blackfin, bluefin, skipjack, and yellowfin) were 251,000 tons, up 12 percent. Contract prices for tuna delivered by U.S. vessels to U.S. canneries increased dramatically in 1987. Depending on the size of fish in the delivery, ex-vessel prices of white-meat tuna increased as much as 27 percent, and prices of light-meat tuna increased as much as 47 percent.

U.S. cannery receipts of imported and domestically caught raw frozen tuna for canning totaled 532,704 tons in 1987, up 2 percent from 1986 levels. U.S. cannery receipts of white-meat tuna were 104,197 tons, down 10 percent from 1986. Imports made up 97 percent of the total cannery supply. Total 1987 U.S. cannery receipts of raw, frozen light-meat tuna were 428,507 tons, up 5 percent from 1986 levels. Imports made up 41 percent of the total cannery supply.

The 1987 U.S. pack of canned tuna was 33.6 million standard cases, up 3 percent from 1986. The pack of white-meat tuna was 7.2 million standard cases, down 11 percent from 1986; the pack of light-meat tuna was 26.4 million standard cases, up 7 percent. U.S. imports of canned tuna in 1987 were 10.8 million standard cases, down 11 percent from 1986 levels, the first time in recent years that imports have declined. Per capita consumption of canned tuna in the United States was 3.5 pounds in 1987, down slightly from 1986. The retail composite price was $2.26 per pound, unchanged from 1986.

Introduction

The U.S. canned tuna harvesting/processing industry is an active participant in the global tuna industry. In 1986 U.S. vessels took 8 percent of the total world catch of all tuna species[1]. Having developed canned tuna processing in the early 1900's, the U.S. processing sector is the world leader accounting for 36 percent of total world canned tuna production in 1986. The United States continues as the major world market for canned tuna, consuming 34 percent of total world production in 1987.

The United States, along with Japan, Spain, and France, other historically dominant tuna harvesting and processing nations, have in recent years met increasing competition from rapidly expanding tuna industries in southeast Asia, Latin America, the western Pacific, and Africa. The world tuna catch was 3,768,000 short tons (tons) in 1986, an increase of 39 percent from 1979. However, while catches in the historical tuna countries increased 24 percent, catches in developing countries increased 53 percent. U.S. landings increased 14 percent over the period. In 1986, the United States was fourth in volume of tuna catches behind Japan, Indonesia, and the Philippines.

Global production of canned tuna was 775,000 tons in 1985, 16 percent above 1979 production. As for catches, this growth is concentrated in developing nations where, from 1979 to 1985, canned tuna production increased 86 percent. In contrast, production increased 5 percent in the historical tuna nations. Canned tuna production in the United States decreased slightly between 1979 and 1985 then increased in 1986. The United States continues as the leading processor of canned tuna.

International trade in raw tuna and canned tuna products has also increased, paralleling the increases in fishing and canning sectors. In 1986, 861,000 tons of fresh and frozen raw tuna were traded by major trading nations, an increase of 47 percent over 1979 levels[2]. The major growth has been in developing countries where raw tuna imports increased 316 percent between 1979 and 1986. Raw tuna imports to developed countries increased only 4 percent and U.S. imports actually declined 2 percent over the period. The United States accounted for 24 percent of total world imports of raw tuna for canning in 1986.

World canned tuna producers exported 315,000 tons of canned product in 1985, up 140 percent from 1979. Virtually all this growth has been in developing countries. The United States continues as the major world importer of canned tuna. U.S. imports were 92,500 tons in 1986, up 215 percent from 1979.

This is the sixth annual review of the U.S. tuna canning industry (Herrick, 1984; Herrick and Koplin, 1984; Herrick and Koplin, 1986; Herrick and Koplin, 1987; Herrick, et al.[3]). In the following sections we describe the industry's performance in 1987. In the first section we

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[1]Food and Agriculture Organization of the United Nations. GLOBEFISH, a computerized system of market information.

[2]In 1987, 97 percent of the raw tuna traded was traded by, in order of volume, the United States, Thailand, Japan, Italy, the Ivory Coast, Singapore, Senegal, France, Spain, Ghana, and Portugal.

Table 1.—U.S. cannery receipts (short tons) of raw tuna by processing site and direct exports, 1982-87[1].

	California/American Samoa/Hawaii						C/AS/H	Puerto Rico						P.R.
	1982	1983	1984	1985	1986	1987	1982-86 avg.	1982	1983	1984	1985	1986	1987	1982-86 avg.
Domestic														
Albacore	6,965	10,466	10,323	5,608	3,231	1,971	7,318		4	3,565	1,245	296	865	1,022
Skipjack	82,669	113,465	94,152	66,716	71,803	75,210	85,762	18,781	41,608	51,441	17,304	18,802	12,105	29,587
Yellowfin[2]	93,468	90,052	59,907	35,365	57,120	83,524	67,182	24,800	30,044	35,193	87,571	75,941	80,261	50,710
Subtotal	183,102	213,983	164,382	107,689	132,154	160,705	160,262	43,581	71,656	90,199	106,120	95,036	93,231	81,319
Imported														
Albacore	33,928	22,750	21,962	20,030	25,811	25,468	24,896	60,670	50,105	70,882	75,122	86,481	75,893	68,652
Skipjack	45,837	50,633	28,737	18,026	18,590	22,618	32,365	82,178	84,675	106,136	74,606	86,441	72,440	86,807
Yellowfin[2]	17,811	14,081	12,685	10,169	11,875	18,384	13,325	33,402	24,251	29,045	57,192	67,260	63,965	42,230
Subtotal	87,576	87,464	63,384	48,225	56,276	66,427	70,586	176,250	159,031	206,063	206,920	240,182	212,298	197,689
Grand total	280,678	301,447	227,766	155,914	188,430	227,175	230,848	219,831	230,687	296,262	313,040	335,221	305,529	279,008

	Direct exports[3]						Dir.exp.	Total						Overall
	1982	1983	1984	1985	1986	1987	1982-86 avg.	1982	1983	1984	1985	1986	1987	1982-86 avg.
Domestic														
Albacore	62		108			841	34	7,027	10,470	13,996	6,853	3,527	3,677	8,374
Skipjack	387	45	15,388	19,669	22,207	16,256	11,539	101,837	155,118	160,981	103,989	112,812	103,571	126,888
Yellowfin[2]	3,864	538	16,980	15,128	11,539	12,866	9,610	122,132	120,634	112,080	138,064	144,600	176,651	127,502
Subtotal	4,313	583	32,476	34,797	33,746	29,963	21,183	230,996	286,222	287,057	248,606	260,939	283,899	262,764
Imported														
Albacore								94,598	72,855	92,844	95,152	112,292	101,361	93,549
Skipjack								128,015	135,308	134,873	92,632	105,031	95,068	119,172
Yellowfin[2]								51,213	38,332	41,730	67,361	79,135	82,349	55,554
Subtotal								273,826	246,495	269,447	255,145	296,458	278,768	268,275
Grand total	4,313	583	32,476	34,797	33,746	29,963	21,193	504,822	532,717	556,504	503,751	557,397	562,667	531,039

[1]Includes imported and domestically caught tuna destined for canning; excludes U.S.-caught tuna destined for export or for the fresh market; excludes imported tuna destined for the fresh tuna market or designated as flakes and not fit for human consumption.
[2]Includes bigeye, blackfin, and bluefin tuna.
[3]Includes tuna landed directly or transshipped to a foreign country; excludes tuna exported from the U.S. east and west coasts.

review the U.S. albacore fishery and U.S. processing of white meat tuna in 1987. In the second section we focus on the fishery for tropical tunas and processing of light meat tuna. In the third section we describe U.S. imports of canned tuna and, in the fourth, consumption of canned tuna.

White Meat (Albacore) Tuna

Albacore, *Thunnus alalunga*, is the only species that may be canned as white meat tuna in the United States[4]. About 21 percent of the total U.S. tuna pack in 1987 was white meat tuna.

[3]Herrick, S. F., W. W. Parks, and P. J. Donley. 1988. U.S. tuna trade summary, 1986. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Reg. Admin. Rep. SWR-88-3, 23 p.
[4]U.S. Government Printing Office, 1985. 21 Code of Federal regulations. Section 161.190(a) (4) (i).

Production by the U.S. Albacore Fleet

The U.S. albacore fleet consists of about 1,800 vessels, of which about 250 land 90 percent of the catch in any given year (Majors[5]). About 80 percent of the vessels use jig gear, 10 percent pole-and-line gear, and 10 percent either a combination of jig and pole and line or other gear (e.g., gill net). The fleet operates exclusively in the Pacific Ocean. Before 1974, reported catches were taken exclusively within 300 miles of the North Pacific coast of North American from central Baja California to British Columbia (Majors, 1987). As a result of joint NMFS/American Fishermen's Research Foundation (AFRF) exploratory fishing in 1975, larger jigboats in the fleet expanded their operations to areas northwest of Hawaii in the late 1970's and early 1980's. In 1986 and 1987, NMFS/AFRF exploratory fishing located new fishing grounds in the South Pacific. Since then, larger U.S. jigboats have fished in this new area east of New Zealand.

[5]Majors, Tony. 1989. Fishery biologist, NMFS Southwest Fisheries Center, La Jolla, CA 92038. Personal commun., March.

Receipts at U.S. canneries in 1987 of albacore caught by U.S. fishermen continued a decline from a recent high in 1984 (Fig. 1)[6]. Receipts (2,800 tons) were 20 percent less than 1986 receipts and 66 percent less than recent average (1982-86) receipts (Table 1).

Sixty-nine percent of the receipts of

[6]Principal U.S. receiving and processing sites for both white and light meat tuna in 1987 were Mayaguez and Ponce, Puerto Rico; San Pedro, California; and Pago Pago, American Samoa. For reporting purposes, receipts and production data are combined for American Samoa and California.

Table 2.—U.S. cannery ex-vessel (contract) prices (U.S. dollars/short ton) at California/American Samoa/Puerto Rico, 1980-87[1].

Year and period[2]	Albacore		Skipjack				Yellowfin				
	≥9 lb.	<9 lb.	>7.5 lb.	4-7.5 lb.	3-4 lb.	<3 lb.	>20 lb.	7.5-20 lb.	4-7.5 lb.	3-4 lb.	<3 lb.
1980											
B	1,610	1,610	850	850	700	545	950	950	810	810	810
E	1,635	1,635	1,100	1,100	1,000	800	1,200	1,200	1,100	1,100	1,100
1981	1,800	1,800	1,100	1,100	1,100	800	1,200	1,200	1,100	1,100	1,100
1982											
B	1,425	1,425	1,100	1,100	1,100	800	1,200	1,200	1,100	1,100	1,100
M			1,040	1,040	940	740	1,140	1,140	1,040	1,040	1,040
E	1,225	1,000	890	890	700	500	1,170	1,050	890	890	890
1983											
B			950	850	700	420	1,230	1,050	850	700	420
M	1,250	975	900	800	640	420	1,125	990	800	640	400
E			880	780	585	250	1,125	975	780	585	250
1984											
B	1,400	1,125	830	730	500	250	1,085	950	730	500	250
M			850	750	550	250	1,000	900	750	550	250
E	1,150-1,300	875-1,025	763	650	470	235	925	800	650	470	235
1985											
B			708	610	435	200	865	753	610	435	200
M	1,300	950	738	640	500	275	870	758	640	500	275
M	1,150	800	650	590	490	290	815	715	590	490	290
E	1,000	800	700	630	500	300	825	725	630	500	300
1986											
B	1,100	750	700	630	500	300	780-800	700	630	500	300
M			685	615	485	285	765	685	615	485	285
E			700	630	500	300	780	700	630	500	300
1987											
B	1,235	950	685-700	615-630	485-500	283-300	765-780	685-700	615-630	485-500	285-300
M	1,400	950	700-750	630-700	500	300	780-880	700-750	630-700	500	300
M			750	700	500	300	880	750	700	500	300
E			1,000	937	725	450	1,125	1,000	937	725	450

[1]Contract prices may be adjusted at the time of unloading depending upon salt content, temperature of the fish, physical consition of the fish, and other quality criteria.
[2]Period: B = beginning of year, M = midyear (various dates), E = end of year.

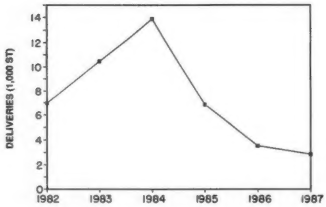

Figure 1.—Deliveries of albacore to U.S. canneries by U.S. fishermen, 1982-87.

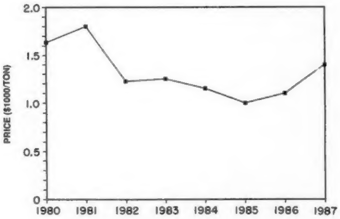

Figure 2.—Contract price for representative size (9 lb and over) albacore paid by U.S. canneries to U.S. fishermen at the end of the year, 1980-87.

Table 3.—U.S. cannery ex-vessel (weighted) prices (US$ per short ton), for domestically caught tuna, 1980-87.

Year	Albacore		Skipjack		Yellowfin	
	Nominal	Real[1]	Nominal	Real[1]	Nominal	Real[1]
1980	1,659	1,929	1,063	1,236	1,180	1,372
1981	1,800	1,908	1,030	1,092	1,170	1,241
1982	1,387	1,387	965	965	1,123	1,123
1983	1,268	1,220	799	769	1,032	993
1984	1,252	1,160	760	704	982	910
1985	1,087	975	622	558	820	735
1986	1,108	968	616	538	743	649
1987	1,496	1,273	716	609	892	759

[1]Adjusted for inflation using GNP implicit price deflator (1982 = 100).

domestically caught albacore delivered to U.S. canneries was received at canneries in American Samoa and California (Table 1). The remaining 31 percent was transshipped to Puerto Rico from west coast ports. In addition, 841 tons of albacore caught by U.S. fishermen in the new south Pacific troll fishery were exported through Tahiti, and an additional 300-400 tons were landed at west coast ports and then exported to Fiji and Japan.

The contract price for domestically caught albacore received at U.S. canneries increased dramatically in 1987 (Fig. 2). The contract price was $1,235 per ton for large fish (9 pounds and larger) at the beginning of 1987, 12 percent greater than the price at the beginning of 1986 (Table 2). The price for small fish (<9 pounds) was $950 per ton, 27 percent greater than the 1986 price. By mid-year, the contract price had risen to $1,400 per ton for large fish. According to industry sources, the general shortage of fish led to canners offering incentives and bonuses for albacore which brought the actual price well over $1,500 per ton.

Price increases offset the decline in landings, and aggregate ex-vessel revenue from the 1987 albacore fishery was 41 percent above that of 1986. Average ex-vessel price (total ex-vessel revenue divided by total domestic cannery receipts) was $1,496 per ton for U.S.-caught albacore in 1987, a 35 percent gain from 1986 (Table 3). The real (inflation

Table 4.—U.S. cannery imports of raw tuna (short tons) by country of origin, 1982-87.

Source[1]	1982 White	1982 Light[2]	1983 White	1983 Light	1984 White	1984 Light	1985 White	1985 Light	1986 White	1986 Light	1987 White	1987 Light
Brazil	1,443	16,181	1,185	15,154	2,018	7,743	710	15,282	218	12,327	373	3,823
Canary Islands	1,693	1	7,653	5	14,030	10	9,415	16	9,184	20	5,802	9
Cayman Islands		6,723				9,960		11,031		8,605		4,706
Ecuador				2,809		12,034		18,722		16,365		12,018
Ghana	1,078	27,783	345	23,751	170	6,640						
Ivory Coast		27,862		13,783	289	30,997		15,887		23,549	297	23,090
Japan	5,834	12,705	696	18,426	10,946	20,965	6,754	718	4,396	922	1,188	
Mauritius	4,811		4,688		5,026		5,789		6,708	12	8,059	87
Mexico										3,331		19,405
Netherlands Antilles	10,054	1,996	8,560	258	9,619	298	12,110	197	14,723	442	8,246	255
Panama		29,558	1	8,110	424	13,928		15,138		24,684		7,205
Philippines		5,923		6,476		1,327						
Reunion	12,036	146	7,438	3	4,363	67	1,521	756	3,605	232	2,629	2,643
Seychelles				3,042		8,257	262	17,064		30,866	51	27,508
Singapore	1,386	3,846	4,217	3,761	5,024		2,562		284		6,022	
Solomon Islands		928		10,600		15,836		3,390				9,088
South Africa	17,044	1	7,304	239	11,856	1,478	21,101		26,905	1	23,194	2
South Korea	1,001	6,891	5,374	13,830	2,119	11,064	8,874	9,747	11,408	20,673	10,920	23,942
Taiwan	99	384	5,075	3,851	9,739	9,468	5,947	10,592	11,283	3,324	13,689	4,073
Uruguay	8,835	670	4,480	143	3,228	722	7,425	1,997	9,652	26	6,237	2
Venezuela		2,421	1	6,604		7,002	147	33,538	28	27,450	6	18,675
Other	29,285	35,209	15,858	42,795	13,993	18,807	12,535	5,918	13,898	11,337	14,648	20,786
Total	94,599	179,228	72,855	173,640	92,844	176,603	95,152	159,993	112,292	184,166	101,361	177,407

[1]The flag of the catcher vessel, country of export, or country though which the tuna is transshipped.
[2]Includes bigeye, blackfin, bluefin, skipjack, and yellowfin tunas.

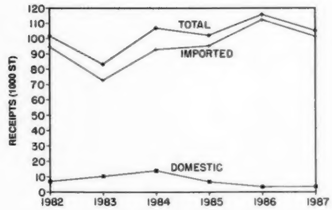

Figure 3.—Receipts of albacore by U.S. canneries by source, 1982-87.

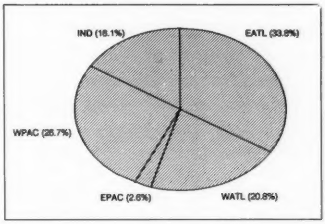

Figure 4.—U.S. cannery receipts and direct exports of albacore by ocean of origin, 1982-87 (EATL = Eastern Atlantic Ocean; WATL = Western Atlantic Ocean; EPAC = Eastern Pacific Ocean; WPAC = Western Pacific Ocean; IND = Indian Ocean).

adjusted) ex-vessel price increased 32 percent in 1987, the first increase in the period 1980-87.

U.S. Processing of Canned White Meat Tuna

Total receipts (U.S.-caught plus imports) of albacore at U.S. canneries in 1987 were 104,197 tons, 10 percent less than 1986 receipts but 3 percent above recent (1982-86) average receipts (Fig. 3, Table 1). Of the total receipts, 74 percent were delivered to canneries in Puerto Rico, and 26 percent went to canneries in American Samoa and California. Receipts at all locations were down in 1987.

As in each of the last 6 years, imports made up the bulk (97 percent) of U.S. cannery receipts of raw albacore in 1987 (Fig. 3). Imports totaled 101,361 tons, a 10 percent decrease from 1986 (Table 1). Puerto Rico was the major receiving site for albacore imports with 75 percent of the total; American Samoa and California received the remainder. Imports received in Puerto Rico were 12 percent less than in 1986; imports received in American Samoa and California were essentially the same as in 1986.

Foreign-caught tuna entering the United States is listed by U.S. Customs as an export of the shipping nation. In the case of transshipments, the shipping country may not be the harvesting country. This is the case in 1987, for which the principal transshipping nation for albacore imports was South Africa which does not export fish taken by its own vessels to the United States (Table 4). South Africa has been a principal point for albacore transshipped to the United States since 1982 and accounted for 23 percent of total imports in 1987. Although the United States has embargoed imports of most South African products, transshipments of tuna caught by Taiwanese and Japanese albacore vessels have been permitted. Other important transshipping nations included Taiwan and South Korea.

The value of imported raw albacore at U.S. canneries in 1987 was $159.9 million, down 2 percent from 1986[7]. This corresponds to a weighted average price of $1,578 per ton, 9 percent above the average price in 1986.

As in 1985 and 1986, the Atlantic Ocean was the source of most albacore received by U.S. canneries in 1987, followed by the Pacific and Indian Oceans (Fig. 4).

[7]Values of raw, imported tuna are computed using declared value reported by importers to the Bureau of Census and import volume compiled by Statistics and Market News Service, NMFS Southwest Region.

Table 5.—U.S. cannery receipts (short tons) of domestically caught raw tuna and direct exports by ocean of origin, 1982-87[1].

Ocean	Albacore						Albacore	Skipjack						Skipjack
	1982	1983	1984	1985	1986	1987	1982-86 avg.	1982	1983	1984	1985	1986	1987	1982-86 avg.
E. Atlantic	62						12	27	21					10
W. Atlantic		4		1			1		3	944	2,079	1,825	884	970
E. Pacific	5,099	9,434	13,409	6,021	3,158	2,589	7,424	59,264	40,181	22,359	4,992	7,938	14,845	26,947
W. Pacific	1,866	1,032	587	831	369	1,088	937	42,546	114,931	137,678	96,618	103,049	87,842	98,961
Total	7,027	10,470	13,996	6,853	3,527	3,677	8,374	101,837	155,118	160,981	103,689	112,812	103,571	126,888

Ocean	Yellowfin[2]						Yellowfin	Total						Overall
	1982	1983	1984	1985	1986	1987	1982-86 avg.	1982	1983	1984	1985	1986	1987	1982-86 avg.
E. Atlantic	1,087						217	1,176	21					239
W. Atlantic	115	70	1,550	4,185	839	60	1,352	115	77	2,494	6,265	2,664	944	2,323
E. Pacific	96,640	65,836	60,753	101,897	103,402	106,330	85,711	161,003	115,478	96,521	112,910	114,498	123,734	120,082
W. Pacific	24,290	54,701	49,777	31,982	40,359	70,291	40,222	68,702	170,646	188,042	129,431	143,777	159,221	140,120
Total	122,132	120,634	112,080	138,064	144,600	176,651	127,502	230,996	286,222	287,057	248,606	260,939	283,899	262,764

[1]Includes tuna destined for canning; excludes tuna destined for the fresh market; includes tuna landed directly or transshipped to a foreign country; excludes tuna exported from the U.S east and wests coasts.
[2]Includes bigeye, blackfin, and bluefin tunas.

Table 6.—U.S. cannery receipts (short tons) of imported raw tuna by ocean of origin, 1982-87[1].

Ocean	Albacore						Albacore	Skipjack						Skipjack
	1982	1983	1984	1985	1986	1987	1982-86 avg.	1982	1983	1984	1985	1986	1987	1982-86 avg.
E. Atlantic	19,815	16,935	27,392	30,655	35,475	35,543	26,054	34,358	35,882	10,828	19,713	39,499	17,700	30,040
W. Atlantic	21,129	16,127	17,209	25,486	36,631	21,827	23,316	18,070	9,059	20,650	15,434	14,731	5,000	16,066
E. Pacific	48	243	439			145	146	4,501	9,245	17,146	15,733	10,443	14,418	11,708
W. Pacific	35,374	23,226	32,340	28,667	28,916	26,948	29,705	72,742	72,699	30,427	24,604	63,001	29,059	48,898
Indian	18,232	16,324	15,464	10,344	11,27	16,898	14,327	5,637	7,988	13,581	29,547	8,094	28,881	12,460
Total	94,598	72,855	92,844	95,152	112,292	101,361	93,548	135,308	134,873	92,632	105,031	135,768	95,058	119,172

Ocean	Yellowfin[2]						Yellowfin	Total						Overall
	1982	1983	1984	1985	1986	1987	1982-86 avg.	1982	1983	1984	1985	1986	1987	1982-86 avg.
E. Atlantic	9,320	4,618	3,258	5,075	5,949	5,403	5,644	55,911	66,532	46,558	61,137	70,246	58,646	61,738
W. Atlantic	3,058	6,446	3,259	10,910	5,507	3,201	5,836	40,643	29,527	57,046	57,572	39,875	30,028	45,218
E. Pacific	19,200	7,492	9,222	29,572	46,945	48,180	22,486	12,236	18,906	46,718	62,678	26,898	62,743	34,340
W. Pacific	18,800	18,814	23,799	15,262	14,380	19,291	18,211	114,782	128,838	74,356	67,900	119,253	75,298	96,814
Indian	835	532	2,192	6,542	6,354	6,274	3,377	22,923	25,644	30,467	47,171	24,490	52,053	30,164
Total	51,213	38,332	41,730	67,361	79,135	82,349	55,554	246,495	269,447	255,145	296,458	280,762	278,768	268,274

[1]Includes inported tuna destined for canning; excludes tuna des. ned for the fresh tuna market or designated as flakes and not fit for human consumption.
[2]Includes bigeye, blackfin, and bluefin tunas.

All albacore received from the Atlantic and Indian Oceans consisted of imports. Receipts of albacore from the Atlantic Ocean decreased 20 percent from 1986, receipts from the Pacific decreased 5 percent, and those from the Indian Ocean increased 50 percent (Table 5, 6).

With the exception of the record 1986 pack, the 1987 U.S. pack of white meat tuna, 7.2 million standard cases, was the largest since 1978; the 1987 pack was 11 percent less than the record 1986 pack (Fig. 5, Table 7)[8].

During 1987, wholesale list prices for U.S.-produced nationally advertised brands of white meat tuna ranged between \$55.40 and \$63.57 per standard case. With discounts, wholesale prices fell below \$49.00 a standard case. Whole-

[8]A standard case consists of 48 6.5-ounce cans of 19.5 pounds.

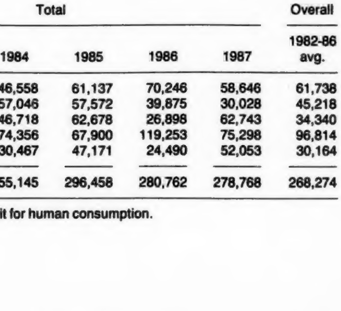

Figure 5.—U.S. production of canned white meat tuna, 1975-87.

Table 7.—Additions to the U.S. supply of canned tuna, volume and value, by source and form, 1975-87.

	Domestic			
Year	White	Light	Imported	Total
	Volume (1,000 standard cases[1])			
1975	5,296	21,854	2,650	29,800
1976	6,312	24,416	3,020	33,748
1977	6,559	21,544	1,776	29,879
1978	7,528	28,615	2,655	38,798
1979	6,129	25,678	2,754	34,561
1980	5,825	25,049	3,259	34,133
1981	6,204	25,948	3,633	35,785
1982	6,416	21,199	4,491	32,106
1983	5,444	24,844	6,273	36,561
1984	7,012	24,489	8,324	39,825
1985	6,764	21,185	10,972	38,921
1986	8,069	24,589	12,134	44,792
1987	7,174	26,364	10,856	44,394
	Value (U.S. dollars)			
1975	136,678	515,957	45,951	698,586
1976	212,869	640,594	67,502	920,965
1977	240,734	665,880	44,658	951,272
1978	296,506	976,754	63,822	1,337,082
1979	243,851	859,998	65,071	1,168,920
1980	252,290	891,237	97,254	1,240,781
1981	294,292	885,846	110,359	1,290,497
1982	275,400	643,046	113,346	1,031,792
1983	197,011	661,586	137,324	995,921
1984	255,997	616,280	167,268	1,039,545
1985	269,887	550,882	209,138	1,029,907
1986	320,795	560,723	227,919	1,109,437
1987	313,611	704,048	206,920	1,224,579

[1]Standard case = 48 6.5-ounce cans.
Sources for domestic data: U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv. 1976-87. Fisheries of the United States, 1976-1987. Curr. Fish. Stat. 6900, 7200, 7500, 7800, 8000, 8100, 8200, 8300, 8320, 8360, 8385, 8700, var. pagin. Also, U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv. 1975-85. Canned Fishery Products, 1975-1984. Curr. Fish. Stat. 6701, 6901, 7201, 7501, 7801, 8001, 8101, 8201, 8301, 8319, 8359, var. pagin.
Sources for import data: U.S. Dep. Commer., Bur. Census computerized data files, 1974-87.

sale prices for private brands ranged between $43.50 and $51.50.

The value of the U.S. white meat pack was $314 million (FOB plant value) in 1987, down 2 percent from 1986 (Table 7). Dividing value by production yields a weighted average price of $43.71 per standard case in 1987, an increase of 10 percent over the average value in 1986.

Light Meat Tuna

In the United States, tuna with flesh color lighter than Munsell value 5.3 may be canned as light meat tuna[9]. Seventy-nine percent of the U.S. pack in 1987 was light meat tuna. The 6.5-ounce can of chunk style, light meat tuna in water has for several years been the most popular tuna product consumed in the United States.

Production by the U.S. Tropical Tuna Fleet

The U.S.-flag, tropical tuna fleet began fishing in the early 1900's off the coast of California (Greenough and Joseph, 1986; Joseph[10]). In the early years, the fleet consisted entirely of baitboats (pole and line gear). Beginning in the mid-1950's, larger baitboats were converted to purse seine, which in the 1960's became the dominant gear. During the mid-1960's to mid-1970's the fleet expanded rapidly as new and larger purse seiners were constructed. The baitboat fishery was concentrated in coastal areas and near offshore islands near supplies of baitfish. As purse seining became the dominant gear, the fleet expanded its operations to offshore regions of the eastern Pacific, to the Atlantic in some years, and in the late 1970's and particularly after 1982, to the western Pacific.

At the beginning of 1987, the U.S.-flag, tropical tuna fleet consisted of 85 vessels with an overall carrying capacity of [illegible]8,252 tons: 80 purse seiners and 5 baitboats. By the end of 1987, the fleet had declined to 83 vessels (76 purse seiners and 7 baitboats) with a total carrying capacity of 81,279 tons. Nine of the 83 vessels were inactive.

During 1987, the U.S. tuna fleet operated exclusively in the Pacific Ocean. There were 34 vessels active in the western Pacific during the first quarter with a combined carrying capacity of 41,255 tons. By the end of the year the number in the western Pacific had declined to 29 vessels with a capacity of 35,875 tons, a 15 percent decrease in number and a 13 percent decrease in capacity. Thirty-five vessels with a total carrying capacity of 33,263 tons operated in the eastern Pacific during the first quarter, increasing to 45 vessels with a capacity of 37,829 tons

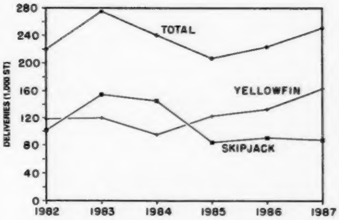

Figure 6.—Deliveries of light meat tuna to U.S. canneries by U.S. fishermen by species, 1982-1987.

by the end of the year, a 22 percent increase in number and 12 percent increase in capacity.

Receipts of domestically caught, light meat tuna at U.S. canneries in 1987, 251,100 tons, were the highest since 1983, 12 percent above the 1986 receipts and 8 percent above recent average receipts (Fig. 6, Table 1). As in 1985 and 1986, receipts of yellowfin tuna exceeded skipjack receipts, comprising 65 percent of the total. Yellowfin receipts (includes small amounts of bigeye, bluefin and blackfin tuna) increased 23 percent over 1986 receipts while skipjack receipts decreased 4 percent.

Sixty-three percent of domestic deliveries to U.S. canneries were to American Samoa and California canneries and 37 percent went to Puerto Rico canneries[11]. Receipts at American Samoa and California in 1987 were 158,734 tons, up 23 percent from 1986 receipts. Receipts at Puerto Rico were 92,366 tons, down 3 percent from 1986.

In addition to receipts at U.S. canneries, U.S.-flag vessels exported 16,256 tons of skipjack tuna and 12,866 tons of yellowfin tuna to foreign canneries in 1987, down 27 percent for skipjack and up 12 percent for yellowfin from 1986.

Owing to increased worldwide demand for raw tuna, contract ex-vessel prices for frozen light meat tuna increased dramatically in 1987 (e.g., up 47 percent for yellowfin tuna >20 lb.) (Fig. 7). In January, contract ex-vessel prices (without quality adjustments) for frozen light

[9]The U.S. Food and Drug Administration lists the following as species that may be canned as light meat tuna: *Thunnus thynnus* (also *T. orientalis*), northern bluefin tuna; *T. maccoyii*, southern bluefin tuna; *T. alalunga*, albacore; *T. atlanticus*, blackfin tuna; *T. obesus*, bigeye tuna; *T. albacares*, yellowfin tuna; *T. tonggol*, longtail tuna; *Katsuwonus pelamis*, skipjack tuna; *Euthynnus affinis*, kawakawa; *E. alletteratus*, little tunny; *E. lineatus*, black skipjack. (U.S. Gov. Print. Off. 1985. 21 Code Fed. Reg. Sect. 161.190 (a) (2)).

[10]Joseph, J. 1988. A review of the fishery for tropical tunas in the eastern Pacific Ocean. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Reg./Southwest Fish. Cent., Tuna Newsl. (90):5-7.

[11]The majority of landings in the category American Samoa/California are in American Samoa. The category is used to maintain confidentiality.

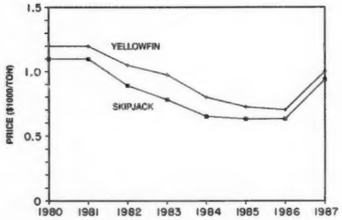

Figure 7.—Contract price for representative size skipjack (4-7.5 lb) and yellowfin (7.5-20 lb) tuna paid by U.S. canneries to U.S. fishermen at the end of the year, 1980-87.

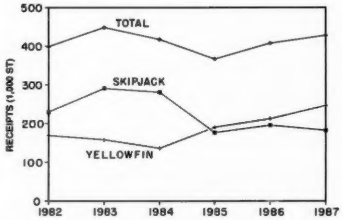

Figure 8.—Receipts of light meat tuna by U.S. canneries by species, 1982-1987.

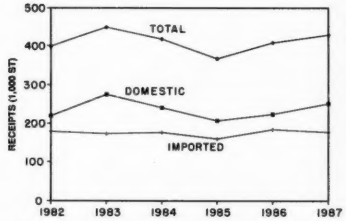

Figure 9.—Receipts of light meat tuna by U.S. canneries by source, 1982-87.

meat tuna in all species and size categories were at a low level (Table 2). Contract prices rose through July then held steady through the remainder of the year. Vessels which chose to sail without contracts were able to command premiums of $20-40 per ton or more above contract prices. For a short period in the fall of 1987, premiums reached a high as $300 per ton[12].

Total ex-vessel revenue from the sale of U.S.-caught light meat tuna was about $208.6 million in 1987, 35 percent greater than in 1986. The ex-vessel value of domestically caught skipjack tuna delivered to U.S. canneries was $62.5 million, up 12 percent from 1986. The average ex-vessel price (total revenue divided by total domestic receipts) was $716 per ton, a 16 percent increase from 1986 (Table 4). The ex-vessel value of domestically caught receipts of yellowfin tuna was $146.1 million in 1987, 48 percent above 1986. The average ex-vessel price for yellowfin tuna in 1987 was $892 per ton, an increase of 20 percent from 1986.

U.S. Processing of Canned Light Meat Tuna

Total receipts (U.S.-caught plus imports) of raw light meat tuna at U.S. canneries in 1987 (428,507 tons) were at their highest levels since 1983, up 5 percent from both 1986 and recent (1982-86) average receipts (Fig. 8, Table 1). Fifty-three percent of total deliveries were to canneries in Puerto Rico, the rest to canneries in American Samoa and California. Receipts at Puerto Rican canneries were 8 percent less than in 1986. Receipts at American Samoa and California canneries were 25 percent more than in 1986.

As in 1985 and 1986, receipts of yellowfin exceeded receipts of skipjack in 1987 (Fig. 8), and 57 percent of raw tuna deliveries consisted of yellowfin, the rest of skipjack. Receipts of domestically caught raw light meat tuna at U.S. canneries in 1987 continued to exceed imports (Fig. 9). Imports, 177,407 tons, made up 41 percent of total raw light meat receipts in 1987 vs. 45 percent in 1986 (Table 1).

Puerto Rico was the major receiving site for imports of raw light meat tuna during 1987, accounting for 77 percent of the total tonnage, compared with 83 percent in 1986 (Table 1). Skipjack tuna made up 54 percent of the 1987 light meat imports, yellowfin the balance. Overall, skipjack tuna imports were down 9 percent from 1986, while yellowfin imports increased 4 percent.

The principal transshipping point for raw light meat tuna imported to the United States in 1987 was the Seychelles, the base of the French and Spanish purse seine fleets operating in the Indian Ocean (Table 4). Of total imports, 16 percent or 27,508 tons was transshipped from the Seychelles. South Korea was the second most important transshipping point, followed by the Ivory Coast. Transshipments of raw light meat tuna from the Seychelles to the United States began in 1983. Since then, Seychelles transshipments have grown and dominated U.S. imports in 1986 and 1987.

Mexico exported 19,405 tons of light meat tuna (does not include non-Mexican caught, transshipped fish) to the United States in 1987, the first full year after the U.S. embargo on imports of Mexican-caught tuna and tuna products ended. When the embargo was lifted, Mexico agreed to voluntarily limit its exports of tuna products to the United States for 3 years, beginning 1 September 1986. At the end of the first agreement year, 31 August 1987, Mexican exports to the United States totaled 16,600 tons, less than the agreed total of 19,200 tons. The agreement calls for limits of 24,000 tons and 30,300 tons in the second and third years, respectively.

The total value of raw light meat tuna imports in 1987 was $135.2 million, down 10 percent from 1986. Skipjack imports were valued at $64.6 million, a decrease of 19 percent from 1986. Yellowfin imports were valued at $70.6 million, the same as in 1986. The weighted average price of imported skipjack tuna was $679 per ton, a decrease of 11 percent from the 1986 price. The price of imported yellowfin funa was $857 per ton, a 5 percent decrease.

The Pacific Ocean continued to be the primary source of all light meat cannery receipts and U.S. direct exports of light meat tuna in 1987, followed by the Atlantic and Indian Oceans (Fig. 10). Total receipts and direct exports were 457,629 tons, of which the Pacific provided 85 percent (Tables 5, 6).

On a regional basis, the western Pacific was the leading production area for U.S. cannery receipts plus direct exports of light meat tuna, with 206,483 tons. Of

[12]Tim McCarthy, Executive Vice President and General Manager, Bumble Bee Seafoods, Inc., P.O. Box 23508, San Diego, CA 92123. Personal commun., Jan. 1989.

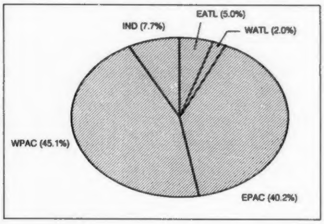

Figure 10.—U.S. cannery receipts and direct exports of light meat tuna by ocean of origin, 1982-87. (Legend abbreviations as in Fig. 5.)

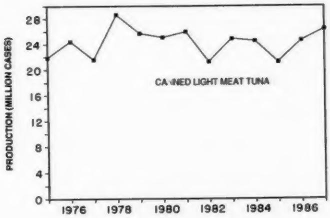

Figure 11.—U.S. production of canned light meat tuna, 1975-87.

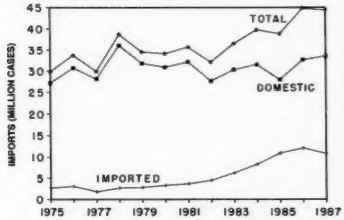

Figure 12.—Additions to the U.S. supply of canned tuna by source, 1975-87.

this total, 77 percent (158,133 tons) was domestically caught and the remainder imported. Skipjack tuna was the predominant species in western Pacific receipts and exports (57 percent of the total). Other oceanic regions contributing, in order of importance, were the eastern Pacific (primarily domestically caught yellowfin tuna), the Indian Ocean (primarily skipjack imports), the eastern Atlantic, and the western Atlantic.

In 1987, the U.S. pack of canned light meat tuna was at its highest level since 1978 (Fig. 11). The pack was 26.4 million standard cases, up 7 percent from 1986 (Table 7).

The wholesale list price of U.S. produced, advertised-label, light meat tuna ranged between $34.20 and $45.00 a standard case, but with discounts the price fell as low as $26.00 a case during the year. Wholesale list prices for private-label light meat tuna ranged between $23.00 and $31.50.

Total production of canned light meat tuna, both name- and private-label brands, was valued at $704 million (FOB plant value) in 1987, up 26 percent from 1986. The weighted average price was $26.70 per standard case, an increase of 17 percent from 1986.

U.S. Imports of Canned Tuna

The United States imported 10.8 million standard cases (105,800 tons) of canned tuna in 1987 (Table 7). Imports actually declined in 1987, the first reversal of the spectacular increase in imports (a compound annual increase of 17 percent) which began in 1978 (Fig. 12). Imports in 1987 decreased 11 percent from 1986 (Table 7).

Foreign-processed canned tuna is subject to an import tariff. Tuna canned in oil is subject to a 35 percent ad valorem tariff. Tuna canned not in oil is subject to a tariff rate quota which allows imports of up to 20 percent of the previous year's domestic production to enter at 6 percent ad valorem. Imports in excess of the quota level enter at 12.5 percent ad valorem. The 1987 quota was 45,750 tons (4.7 million standard cases).

An indication of the rates of imports is the date on which the quota is reached. In 1987, the quota was reached on April 4, the earliest closure date since the quota program began.

The majority (86 percent) of canned imports were of light meat tuna (in water) at 9.4 million standard cases (91,000 tons). White meat tuna in water contributed 13 percent at 1.4 million cases (14,700 tons). One percent of 1987 canned imports were of tuna canned in oil. Due to the high tariff, U.S. imports of tuna packed in oil have never been large and in 1987, 16,800 standard cases (164 tons) were imported.

Thailand, Taiwan, the Philippines, and Japan were the major exporters of canned tuna to the United States in 1987, as they have been since 1982 (Table 8). Thailand was the leader, shipping 73,400 tons (7.5 million standard cases), 70 percent of total 1987 U.S. imports.

The value of imported, canned tuna in 1987 was $207 million (FOB plant value not including duty) (Table 8). The weighted average price of imports was $1,940 per ton or $18.87 per standard case, the same as in 1986.

U.S. Consumption of Canned Tuna

Per capita consumption of canned tuna products in the United States for 1987 (excluding noncivilian consumption) was 3.5 pounds, 3 percent less than in 1986. According to industry reports, 78 percent of 1987 U.S. canned tuna consumption was of light meat tuna and 22 percent was of white meat. Based on these proportions, per capita consumption of white meat was 0.77 pounds (1.9 standard cans), 1 percent less than in 1986. Per capita consumption of light meat tuna in 1987 was 2.73 pounds or 6.7 standard cans, 4 percent less than in 1986.

The retail composite canned tuna price (an average weighted by volume of product type) was $2.26 per pound in 1987, unchanged from 1986. The composite price for canned white meat tuna was $3.21 per pound; the price for light meat tuna was $1.99 per pound. Based on per capita consumption, 1987 U.S. per capita expenditure for canned tuna was $7.91, $2.47 for white meat tuna and $5.44 for light meat tuna.

Discussion

Generally, 1987 was a good year for the U.S. tuna industry. Domestic cannery receipts and production were up, as were ex-vessel and wholesale prices. U.S. landings of light meat tuna were up in 1987, while foreign catches, particularly from the Atlantic and Indian Oceans, were down, creating tight supplies in a strong global market and, as a result,

Table 8.—U.S. Imports of canned tuna (oil and water), by principal sources, 1982-1987.

	Quantity (1,000 pounds)						Value (U.S. $1,000)					
Source	1982	1983	1984	1985	1986	1987	1982	1983	1984	1985	1986	1987
Canada	2	2,106		88	9	83	5	2,986		75	7	63
Ecuador			890	5,175	2,886	5,112			837	4,676	2,603	4,481
Indonesia	595	2,634	2,222	1,388	815	1,505	699	2,679	2,102	1,186	690	1,248
Japan	25,481	20,387	26,855	23,703	10,558	4,688	38,561	24,643	29,186	28,142	14,755	7,375
Malaysia	755	3,083	1,608	3,878	2,401	1,573	1,242	4,068	1,893	4,498	3,160	1,985
Philippines	27,631	32,018	22,225	30,797	27,982	20,858	31,085	32,291	20,396	25,930	23,124	16,576
South Korea	49	68	82	58	1,443	306	79	69	75	58	1,230	267
Spain[1]	120	133	214	336	237	198	300	268	376	560	557	588
Taiwan	10,704	18,710	17,935	23,472	28,579	25,924	14,366	22,772	22,475	29,801	34,483	34,809
Thailand	18,667	39,930	89,685	122,666	152,297	146,928	22,711	43,259	89,253	111,852	139,561	135,368
Other	2,575	3,260	597	2,387	9,414	4,510	4,299	4,289	677	2,360	8,456	4,160
Total	86,479	122,329	162,313	213,948	236,621	211,685	113,347	137,324	167,270	209,138	228,626	206,920

[1]Mainly oil packed.
Sources: U.S. Dep. Commer., Bur. Census computerized data files, 1982-1987.

higher ex-vessel prices. With the increase in landings and ex-vessel prices, earnings by the U.S. fleet increased significantly.

While eastern Pacific fishing grounds continue to be of key importance to the U.S. purse seine fleet fishing for tropical light meat tunas, the importance of western Pacific grounds increased as access became more assured with the signing, in 1987, of an agreement between the United States and South Pacific nations allowing U.S. vessels access to South Pacific fishing zones. The agreement was precipitated by jurisdictional claims by many Pacific island states over tuna in 200-n.mi. extended economic zones (EEZ's) and problems caused when, in the early 1980's, several U.S. vessels were seized for fishing in claimed island exclusive fishing zones. Seizures triggered relaliatory U.S. embargoes on imports of tuna products from the seizing nations as provided for by the Magnuson Fishery Conservation and Management Act.

To resolve these problems, the United States and 16 Pacific island states negotiated a regional licensing arrangement, signing a treaty formalizing the arrangement in 1987. Terms of the treaty grant U.S. vessels fishing rights within fishing zones of a large region of the South Pacific Ocean and provide for license fees and technical and economic assistance to the South Pacific states. Negotiations leading to a treaty arrangement allowing for U.S. access to EEZ's of Central and South American nations and for collective management of eastern Pacific tuna resources continued in 1987 but have yet to yield an agreement.

A bright spot for U.S. tuna fishermen was the devleoping South Pacific albacore fishery. In the face of continuing declines in landings by the U.S. albacore fleet from its traditional west coast grounds, efforts to develop new grounds in the South Pacific began in 1986. Initial fishing success and high demand for albacore prompted U.S. jigboats to develop the southern fishery. Between January and April, 1987, seven U.S. jigboats operated in the central South Pacific catching 840 tons of albacore. Catches were landed in Tahiti and sold at an average price of $1,300 per ton.

Worldwide, the demand for canned tuna, and hence raw tuna, was up in 1987 while harvests in some areas were down. This contributed to increases in ex-vessel and wholesale prices. The European tuna industry, being much more vulnerable to the shortfall in raw tuna production from the Atlantic and Indian Oceans, was unable to satisfy increasing European demand for canned tuna, and in 1987 much of the foreign processed canned tuna, as well as foreign caught raw tuna, entered European rather than U.S. markets. U.S. imports of canned tuna were down 11 percent from 1986 levels, the first time in recent years than imports have declined.

U.S. processors took advantage of the 1987 global tuna situation and increased their share of the domestic canned tuna market, and U.S. cannery production rose. Nonetheless, with the decline in imports, the total amount of canned tuna available to U.S. consumers fell 1 percent from 1986. Since U.S. canned tuna consumption was down slightly in 1987, the overall decrease in supply would help explain the improvement in wholesale canned tuna prices, and an unchanged composite retail price from 1986.

Acknowledgments

This review would have been impossible without the support of the U.S. tuna canning industry, officials of which continue to voluntarily report data on industry activities—we appreciate their support. We acknowledge the assistance of Diane Pickelsimer, Henry Orr, and Lorraine Prescott, NMFS Southwest Fisheries Center; and Richard Deering, NMFS Southwest Regional Office in preparing this report. We thank the many colleagues, and particularly members of the tuna industry, for their careful review of the manuscript.

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Fox Heads National Marine Fisheries Service

Under Secretary of Commerce for Oceans and Atmosphere John A. Knauss announced on 7 February 1990 the appointment of William W. Fox, Jr., a marine biologist with broad experience in fisheries management and research, to lead the National Marine Fisheries Service (NMFS). Fox will serve as Assistant Administrator for the National Oceanic and Atmospheric Administration (NOAA) division responsible for managing, conserving, and protecting living marine resources, including shellfish and mammals, within waters 200 miles from the U.S. coastline.

"Bill Fox brings to NMFS the unique qualities of fisheries expertise combined with a family background in the practicalities and problems of the seafood industry," Knauss said. "With experience that includes 10 years' previous NOAA service, he is well-versed in the serious challenges posed by overfishing and environmental degradation."

Before taking the NOAA post, Fox was a professor for 7 years at the University of Miami, Rosenstiel School of Marine and Atmospheric Science, where he directed a joint NOAA/University research institute. He administered programs emphasizing research on the ocean-related aspects of climate change and the fisheries aspects of ocean ecosystems dynamics, and coordinated the NOAA Sea Grant program.

"The increasing demand on our fish stocks for recreational use and seafood is a concern for everyone," Fox said. "Since replacing the foreign fleets, our fishermen have been competing among themselves for an ever-shrinking supply of finfish and shellfish in a marine environment acutely susceptible to man-made abuse and pollution. Commercial and recreational fishermen must share in the task of conserving fish stocks so they can be replenished and maintained at healthy levels, and in preserving their estuarine and ocean habitat.

"Government and industry must be prepared to make tough choices in the new decade if we are to bequeath a legacy of wise and prudent use of our marine resources to future generations," Fox added.

Fox said his interest in fisheries management was sparked by an uncle, Arthur B. Jarrell, founder of Jarrell and Read, a seafood wholesaler who urged him to work to conserve fisheries resources in order to ensure a stable supply for the future. Enrolling in the University of Miami, Fox earned his B.S. degree and in 1970 his M.S. in marine science. Two years later he received his doctorate in fisheries science from the University of Washington.


Fox

During his NOAA service starting in 1972, Fox served as chief of the Oceanic Fisheries Resources Division, La Jolla, Calif., from 1975 to 1978. For the next 4 years, he was director of NOAA's Southeast Fisheries Center, Miami, where he administered seven Federal fishery research laboratories before joining the University of Miami faculty. Fox is the author of more than 50 professional publications, reports, and book reviews, and serves on a number of major scientific and public service committees. He was appointed to the Florida Marine Fisheries Commission in 1983, serving as chairman for the last 3 years, and the U.S. Marine Mammal Commission in 1987. He also has served as chairman of the U.S. Commission for the past 2 years. Fox is a member of the American Institute of Fishery Research Biologists, the American Fisheries Society, the American Geophysical Union, and Sigma Xi, the research society. He is married to the former Soledad Milord Loaiya of Panama City, Panama, and is the father of a son and a daughter.

TASK TEAM ON ILLEGAL SALMON

The National Marine Fisheries Service, NOAA, has taken several initiatives to improve the monitoring of illegal Pacific salmon harvesting and trade. As part of this effort, an International Enforcement Information Task Team was created to investigate and document the world trade in illegal salmon. Data is being gathered by U.S. Embassies abroad, the U.S. State Department, and other agencies. The task team also needs industry's cooperation and assistance to obtain data on Pacific salmon imports and exports by foreign firms. Any leads provided would be welcome.

Ideally, the information should include the following for each transaction both from exporting countries (primarily Hong Kong, Singapore, Thailand, South Korea, and Taiwan) and importers (France, Belgium, West Germany, Holland, U.K., Australia, Japan, and others): Specific species (chum, chinook, coho, sockeye, or pink salmon), name of exporter and/or importer, quantity, date of sale, and price per unit. Please transmit data to Milton M. Rose, Task Team Coordinator, telephone (301) 427-2300, fax (301) 427-2001, and mailing address DOC/NOAA/NMFS, Office of Enforcement, 1335 East-West Highway, Silver Spring, MD 20910.

Kemmerer Named Director of NMFS Southeast Region

Andrew J. Kemmerer was appointed Director of National Marine Fisheries Service Southeast Region on 17 December 1989. Kemmerer is located in St. Petersburg, Fla., and he has B.S. and M.S. degrees from the University of Arizona and a Ph.D. in aquatic ecology from the Utah State University. His career has many facets beginning with the Air Force as a Squadron Commander, through the Arizona Game and Fish Department where he started their first fishery research division, to a period with an engineering firm in Hawaii and Washington,

D.C., and then to the National Marine Fisheries Service in 1971 where he began as an acoustician in Pascagoula, Miss.

After an assignment in Washington, D.C., Kemmerer became the Director of the National Fisheries Engineering Laboratory in Mississippi, and, following a reorganization, became the Director of the combined Mississippi Laboratories with facilities in Pascagoula and the Stennis Space Center. Much of Kemmerer's technical career with the National Marine Fisheries Service has been spent in remote sensing and conservation engineering, although more recent activities have included red drum, butterfish, coastal herrings, and sea turtles. His expertise in remote sensing, in particular, has provided him experience internationally. He is a strong advocate of cooperative research with states and universities, being the primary architect of grant programs such as SEAMAP and MARFIN. He received numerous awards for his management and technical skills and was given NOAA's highest award for excellence in engineering.

According to Kemmerer, "Good science is a prerequisite for good fisheries management." He is looking forward to the challenges his new position will bring and believes that by capitalizing on the excellent scientific capabilities available in the Southeast Region, difficult management problems can be resolved without serious conflicts.

Federal Agents Seize Shrimp Boat for Failure to Pay Overdue Fines

Federal agents seized a 62-foot shrimp vessel in Port Isabel, Tex., in November 1989, charging the owner with failure to pay civil fines dating back to 1984. The seizure, which took place on 11 November, was carried out by the U.S. Marshal Service personnel and enforcement agents from the National Oceanic and Atmospheric Administration's National Marine Fisheries Service. The vessel, *Don Enrique*, and its owner, Guadalupe Resendez of Harlingen, Tex., had been involved in several violations of Federal fisheries law in the mid-1980's, according to the Fisheries Service. Current penalties and interest against the vessel then totalled almost $12,000.00.

"I expect we'll see more of these seizures in the near future," said Joseph W. Angelovic, then head of the NMFS Southeast Region in St. Petersburg, Fla. "It's simply unfair to the honest fishermen in the Gulf for us to let people ignore civil fisheries penalties and think they can get away with it," he added. According to Angelovic, the vessel, which was worth about $150,000.00, would be held in Brownsville, Tex., under guard until the fines were paid.

Nations Fail to Reach Accord on Swordfish

Carmen J. Blondin, Deputy Assistant Secretary of Commerce who led the U.S. delegation in late November 1989 to a meeting of the International Commission on the Conservation of Atlantic Tuna (ICCAT), a 22-nation organization that manages highly migratory species such as tunas and swordfish, said that said he was "deeply disappointed" at the failure of Atlantic fishing nations to reach agreement on limiting swordfish catches. The size of the North Atlantic swordfish stock, Blondin said, has declined steadily in recent years, and is now at about 30 percent of the 1978 level.

The meeting, in Madeira, Portugal, ended without agreement among Commission members on restricting swordfish catches. "All our statistics point to real problems," Blondin warned. "The average swordfish caught in the North Atlantic in 1988 was only half the size of those taken in 1978. And the size of the spawning stock—the life blood of the fishery—was down 40 percent during the same period."

"In spite of these gloomy numbers," Blondin said, "ICCAT members were unwilling to take the management steps needed to protect this important species." Blondin was particularly critical of Spain, which, he said, "rejected out of hand any possibility of at least limiting increases in current catch levels."

"Efforts taken by the United States or any other nation will be useless if action isn't ultimately taken by Spain," Blondin said. The Spanish fleet, he added, has been harvesting almost half the total North Atlantic swordfish catch in recent years and has more than tripled its catch in the North Atlantic since 1979. In addition to the United States and Spain, ICCAT members include members of the European Community and African, South American, and Asian countries.

Uniform Code Council Approves Seafood UPC

The Random Weight Seafood Universal Product Code (UPC) System developed by the National Fisheries Education and Research Foundation (NFERF) in cooperation with the National Marine Fisheries Service (NMFS), and the Ad Hoc Committee on Random Measure Product Numbering received official approval from the Dayton, OH-based Uniform Code Council in August 1989. The UPC symbol is a type of bar code used by food retailers to identify grocery items and is the standard for the grocery industry. Until now a standardized system was not available to assign UPC bar codes to fish products sold on a variable weight price-per-pound basis. However, the new seafood UPC codes offer retailers the opportunity to scan random weight seafoods and track items more efficiently at the retail level. It also means that seafood packers can place a bar code, universal to all retailers, on random weight products which will fit into their customers coding systems.

A manual entitled, "Random Weight UPC Numbering System," is available to retail and seafood representatives. It contains 1,575 UPC's for seafood products sold by random weight and uses FDA accepted finfish market names for over 200 species of fish and shellfish. Arranged by three basic sections (finfish, shellfish and other seafoods), the manual is alphabetical by species. UPC's now appear on over 95 percent of the products in retail grocery stores. They streamline product identification and offer the simplest and most accurate, cost-effective approach for identifying products by use of optical scanners. For a copy of "Seafood Random Weight UPC Numbering System," send a $10 check or money order to: NFERF, 2000 M Street, N.W., Suite 580, Washington, D.C. 20036. (Quantity discounts are available.) (SOURCE: NFI Communications.)

The Asian Surimi Industry

The Asian surimi industry is undergoing a period of rapid change as the Republic of Korea, Thailand, New Zealand, and the United States are increasingly challenging Japan's position as the world's leading surimi producer. The appreciation of the yen and the Japanese exclusion from U.S. and Soviet walleye or Alaska pollock resources, have caused Japanese production to decline from its 1984 peak of 418,000 metric tons (t) to only 310,000 t in 1989. Meanwhile, the output of the other four major producing countries has increased from about 26,000 t to 260,000 t during the same period (Fig. 1, Table 1).

The Korean surimi industry shows the greatest potential for independent growth among the Asian surimi producers, with an output of 60,000 t in 1989. The Thai and New Zealand industries also show considerable growth potential, but are at present dependent upon Japanese technical assistance. Quality and adequate raw material resources are the primary obstacles facing these three up-and-coming Asian surimi producers.

Background

Fish paste products have long been a part of traditional Asian cuisine, but surimi has become one of the most dynamic commodities in the Asian seafood industry because of recent innovations in production and utilization. Surimi is an intermediate product made from minced fish meat that has been washed, refined, and treated with cryoprotectants. Although fish paste products have been hand-made for centuries, a process for freezing surimi, invented in 1960, provided the impetus for expanding the industry and surimi markets based on the vast walleye pollock, *Theragra chalcogramma*, resource.

In 1975, Japanese firms introduced imitation crabmeat and analogs of other shellfish, generating much greater interest in surimi overseas than did traditional Japanese surimi-based food products. About 90 percent of Japan's surimi production is used to manufacture traditional products (known as kamaboko), imitation crabmeat (kanikama), scallops, and other analogs (Table 2). The other 10 percent is used to make fish hams and sausages. Surimi can be produced on factory trawlers at sea, or in land-based processing plants. Because fresher fish is used, at-sea surimi is generally considered to be of higher quality than land-based surimi. Walleye pollock is the most commonly used species in surimi production because of its abundance, high gel-forming capability, year-round availability, white color, and pleasant taste. Walleye pollock is predominantly found in the North Pacific, in waters off Alaska, the Bering Sea, and within the Soviet Exclusive Economic Zone (EEZ). As foreign access to pollock stocks in the U.S. and Soviet EEZ's is being reduced, however, other demersal species such as hoki, *Macruronus novaezelandiae*, and blue whiting, *Micromesistius poutassou*, as well as pelagic species such as jack mackerel, *Trachurus japonicus*, and sardine, *Sardinia melanostrichus*, are also being used in surimi production (Table 3). To date, however, producers have not found any single species besides pollock that both satisfies the necessary processing criteria and is sufficiently abundant to supply the growing world market. In the

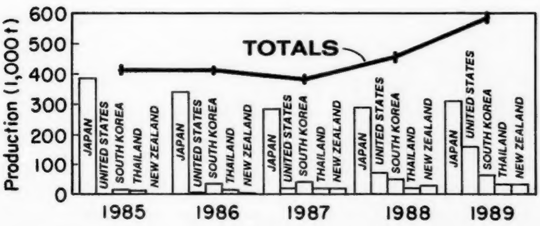

Figure 1.—Major surimi producers and production by country and year, 1985-89 (1988-89 data estimated).

Table 1.—World surimi production by country and year, 1985-89.

	Surimi production (1,000 t)					
Country	1984	1985	1986	1987	1988	1989[1]
Japan	418	385	342	285	290	310
Korea	14	15	34	40	50[2]	60
United States	0	0	4	18	57	141
Thailand	10	11	15	20	20[2]	30
New Zealand	0	0	6	19	28[2]	30

[1]Projected.
[2]Estimated.

Table 2.—General glossary of surimi-related terms[1].

Commodity	Definition
Chikuwa	Broiled kamaboko with a cylindrical shape.
Hanpen	Sponge-like fish cake dumplings for soup made from a boiled kamaboko and ground yam mixture.
Kamaboko	Fish cake made from surimi. Sometimes mixed with ingredients such as starch, egg albumin, and mirin (Japanese sweet liquor). Comprises 90 percent of surimi-based products. May be steamed, fried, or broiled and consumed directly or further processed.
Kanibo	Surimi-based imitation crab legs.
Kanikama	Surimi-based imitation crab meat.
Naruto	Steamed kamaboko with a cylindrical shape containing a pinka nd white spiral pattern on the cross section.
Neriseihin	Any surimi-based processed food product.
Satsuma-age	Surimi-based fish cake patties with vegetables and flavoring added.
Surimi	A semi-processed wet fish protein made from washed and refined minced fish meat mixed with cryoprotectants and sugar. Not for direct consumption.

[1]Source: OECD Multilingual Dictionary of Fish and Fish Products, 1978.

Table 3.—Fish species used for surimi production by common name, fishing grounds, and quantity, 1984-86.[1]

		Production (1,000 t)		
Common name	Fishing grounds	1984	1985	1986
Walleye pollock	N.E. Pacific	1,373	1,399	1,605
	N.W. Pacific	4,614	4,733	5,154
Atlantic cod	N.W. Atlantic	651	635	635
Croaker	W. Indian Ocean	136	146	132
	E. Indian Ocean	36	32	35
Gulf menhaden	Gulf of Mexico	983	884	829
Hoki	S.W. Pacific	55	39	104
Jack mackerel	S.E. Pacific	2,314	2,148	1,958
Pacific whiting	N.E. Atlantic	598	656	799
Southern blue				
Threadfin bream	E. Indian Ocean	74	76	81
Whiting	S.E. Atlantic	113	95	104

[1]Source: FAO data.

Table 4.—Japanese surimi production by type and quantity, 1978-87.

Year	At-sea[1] prod. (t)	Shore-based (t)			Total domestic production (t)
		Pollock	Other	Total	
1978	175,853	177,655	12,075	189,730	365,583
1979	190,621	162,422	14,543	176,965	367,586
1980	179,331	165,818	19,097	184,915	364,246
1981	176,442	160,200	18,280	178,480	354,922
1982	177,095	178,941	17,013	195,154	373,049
1983	153,593	210,855	15,425	226,280	379,873
1984	146,000	248,186	24,258	272,444	418,444
1985	126,067	226,420	32,106	258,526	384,593
1986	101,054	205,074	43,419	248,466	341,833
1987	64,402	195,921	24,406	220,327	284,729
1988	90,000	180,000	20,000	200,000	290,000
1989[2]	120,000	170,000	20,000	190,000	310,000

[1]Produced by Japanese factoryships at sea.
[2]Estimated.

Table 5.—Japanese Alaska pollock directed fishing catch quotas in the U.S. EEZ, by round weight quantity, region and year, 1985-89, and U.S. domestic annual processing allocation (DAP).

Year	Quotas (t)			Total amt. (t)	U.S. DAP (t)
	Bering	Aleutians	Alaska		
1985	594,200	50,900	25,000	670,100	75,900
1986	261,800	36,300	0	298,100	135,100
1987	3,300	0	0	3,300	255,400
1988	0	0	0	0	622,500
1989	0	0	0	0	1,117,200

last 20 years, world demand for surimi-based foods—marketed as inexpensive, healthful alternatives to natural seafood—has grown dramatically, and surimi production, originally dominated by Japan, has spread to over 20 countries in Asia, Europe, and North and South America.

Japan continues to dominate both production and consumption of surimi and surimi-based foods, but other countries have begun to challenge Japan's position in recent years. The U.S. and South Korean industries are particularly dynamic. The U.S. surimi industry has almost doubled in size each year since it was established with Japanese technical assistance in 1986. It is expected to produce over 140,000 t of surimi in 1989. (For an explanation of the Japanese production and import figures used in this report, please see "Note" at end of article.) The South Korean surimi industry, capitalizing on the high Japanese yen, is beginning to displace Japan in the main export markets of Europe and North America. The surimi industries in Thailand and New Zealand also show considerable growth potential. Japan will also eventually have to contend with other countries in Europe (France, United Kingdom, Norway, etc.) and Latin America (Argentina and Chile) which are developing surimi industries.

Japan

Japan's surimi production expanded sharply in the 1950's and 1960's and peaked in 1984 at over 418,000 t (Table 4), accounting for about 95 percent of the total world supply. Production has steadily decreased since 1984, however, for several reasons. First, the United States and the Soviet Union have greatly reduced Japan's allocations of pollock. Second, Japan's consumption and production of surimi-based foods has been declining, leading to reduced domestic demand for surimi. Third, a significantly stronger yen has helped make foreign products much more competitive in both Japanese and foreign markets. Today Japan accounts for less than 75 percent of the world total, producing only about 290,000 t of surimi in 1988.

Raw Materials

The most serious problem facing Japanese surimi processors is reduced access to walleye pollock resources. Because about 80 percent of Japanese surimi is manufactured from walleye pollock, Japan currently requires about 1.5 million t (round-weight) of pollock annually)[1]. Traditionally, Japanese producers relied upon domestic landings for their supply of raw materials. However, the Japanese pollock catch dwindled rapidly when the United States and the Soviet Union established their 200-mile fisheries jurisdictions (in 1976 and 1977, respectively), encompassing major pollock fishing grounds, and began to cut Japanese pollock catch allocations (Table 5).

Currently there is no pollock catch allocation for directed Japanese fishing in the U.S. EEZ. Under the 1989 Japan-U.S.S.R. bilateral groundfish agreement, the Soviets allocated about 121,000 t of pollock to Japanese fishermen. Of this total, 53,480 t was free-of-charge while for the remaining 67,530 t the Japanese have to pay a fee. In response, Japan has moved the bulk of its pollock fishing operations into the highseas "Donut Hole" region in the Bering Sea. Japan has also begun experimenting with the utilization of other fish species for surimi production. New Zealand hoki has been one of the most promising alternative sources of raw materials because of its abundance and the high quality of hoki surimi. But, for 1989, New Zealand reduced its catch allocation to Japan by over 75 percent—to only 2,899 t—bringing independent Japanese fishing in those waters also to a virtual halt. In response, the Japanese appear to be targeting Canadian Pacific hake, Chilean jack mackerel, and various Argentine demersal species.

Japan has also turned to joint venture (JV) agreements with the United States, the Soviet Union, and other countries to ensure access to raw materials. Total joint venture surimi production—whereby Japanese surimi factory vessels purchase Alaska pollock over-the-side from foreign trawlers within their respective EEZ's, and process it at sea—increased from 6,000 t in 1979 to 143,000 t in 1987. This number fell to about 141,000 t in 1988, however, because of decreased U.S. joint venture processing (JVP)

[1]Using a conversion rate from the round-weight to the processed product of 22-25 percent.

Table 6.—Japanese surimi joint ventures[1] by quantity produced and year, 1978-89.

Year	Partner and quantity (t)				Total prod. (t)
	U.S.[2]	U.S.S.R.[2]	DPRK	U.S./Can[3]	
1978	6,000		0	0	6,000
1979	6,000		0	0	6,000
1980	7,225		0	0	7,225
1981	10,750		0	0	10,750
1982	23,444		0	0	23,444
1983	55,659		0	0	55,859
1984	80,282		0	0	80,282
1985	105,156		0	0	105,156
1986	122,668		0	0	122,668
1987	143,210		0	0	143,210
1988[4]	113,500	23,400	2,300	2,000	141,200
1989[4]	31,000	13,800	1,500	6,000	52,300

[1]Although the Japanese Government records joint venture surimi production as an import, the surimi is produced by Japanese factoryships from fish purchased over-the-side from joint venture partners.
[2]Country not specified until 1988.
[3]Pacific hake-based surimi production.
[4]Estimated or projected.

Table 7.—Japanese production of fish paste products by product form and quantity, 1975-87.

Year	Chikuwa	Kamaboko	Fried kamaboko	Other	Subtotal	Ham/sausage	Grand total
1975	259	444	327	10	1,033	121	1,154
1980	174	326	269	18	824	89	913
1983	195	347	297	59	898	98	996
1984	196	330	298	71	896	95	990
1985	200	327	291	73	891	92	984
1986	195	309	276	74	855	91	945
1987	189	307	271	69	836	89	926
1988	190	308	278	61	836	84	920

Table 8.—Prices of Japan's frozen surimi.

Year	Grade[1] (¥/kg)			Year	Grade[1] (¥/kg)		
	A	B	C		A	B	C
1983	400	251	234	1986	492	352	332
1984	412	203	221	1987	480	266	243
1985	426	278	258	1988	NA[2]	200	NA

[1]A = highest grade of offshore product; B = on-land, 1st grade; C = on-land, 2nd grade.
[2]NA = Not available.

Table 9.—Japan surimi imports by major supplier and quantity, 1978-89.

Country	Imports (t)					
	1984	1985	1986	1987	1988	1989
U.S.A.	0	0	0	5,500	30,500	90,000
S. Kor.	1,000	4,000	9,000	8,000	8,000	10,000
Thail.[1]	0	10,000	12,000	21,000	25,000	30,000
Total	1,000	14,000	21,000	34,500	63,500	130,000

[1]May include a small amount from Taiwan.

allocations (Table 6). JV production is expected to fall further in 1989 to a projected 52,000 t. About 23,000 t of surimi was produced through joint ventures with the Soviet Union in 1988. About 50,000 t (round weight) of joint venture pollock purchases are negotiated yearly with North Korea. New Zealand, Thailand, Chile, Argentina, and Canada have also been small-scale joint venture partners.

Production

The Japanese domestic production of surimi has dropped from its peak of 418,000 t in 1984 to 290,000 in 1988 (Table 4) primarily because of recent competition from less expensive U.S. and South Korean imports. The decrease also results from declining demand from surimi-based food processors, as the domestic consumption of their products falls off due to changing Japanese eating habits (Table 7). Prices for all grades of surimi have fallen precipitously since 1987, putting many producers out of business (Table 8).

Imports

The decreasing domestic surimi production has spurred on a dramatic growth of imports from 14,000 t in 1985 to a projected 130,000 t in 1989 (Fig. 2, Table 9). Because of the recent fall in the value of the U.S. dollar and the Korean won against the yen, most of Japan's surimi imports come from the United States and South Korea, although New Zealand, Thailand, and Taiwan also supply small amounts. As U.S. domestic surimi consumption grows, however, U.S. exports to Japan are expected to level off. Although South Korean surimi retains an image of poor quality in the Japanese market, its price, 20-30 percent lower than Japanese surimi, has made it increasingly popular. Industry sources predict that Japan will import 10,000 t of South Korean surimi, and 90,000 t of U.S. surimi in 1989. According to the same sources, the availability of these inexpensive imported materials has permitted Japanese analog producers to cut prices and retain most of their domestic market share.

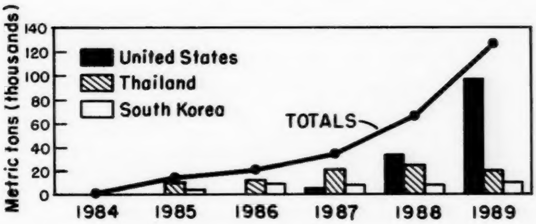

Figure 2.—Japanese surimi imports by major supplier and quantity, 1978-89, not including joint venture production (1989 data estimated).

Japan controls imports through a surimi import quota (IQ) system. The Japanese claim that biannual IQ's prevent foreign countries from oversupplying the Japanese surimi industries by bringing down prices. The pollock surimi IQ is distributed to three major categories of user groups—fishermen, processors, and traders. The fishermen's quota is earmarked for imports of Japan-U.S. joint-

venture processed pollock products (primarily surimi). The processor's quota covers South Korean surimi. Finally, fishermen, processors, and traders are all entitled to use the Overseas Fishery Development (OFD) quota, which applies to imports of surimi and other processed pollock products from countries with pollock resources within their EEZ's. As Japan's access to pollock resources has shrunk in recent years, total import quotas have increased dramatically from 95,000 t (round weight) in fiscal year 1986 to 631,000 t of pollock in fiscal year 1988 (Table 10). With domestic catch and joint venture production falling yearly, this trend is likely to continue.

Table 10.—Pollock surimi import quotas for Japan's fiscal years[1] 1986-88.

Recipient commodity	Import quota (t, round wt.) Apr.-Sept. 1986	Oct. 1986-March 1987	Apr.-Sept. 1987	Oct. 1987-March 1988	Apr.-Sept. 1988	Oct. 1988-March 1989
Fishermen's quota						
Surimikyokai (Japan Surimi Association) (U.S.-processed surimi[2])	10,000	20,000				
Daisui (Japan Fisheries Association)[3] (Japan-U.S. Joint Venture surimi)	10,000	45,000		28,000		NA
Processor's quota						
Zenkama (All Japan Federation of Kamaboko Manufacturers Association) ROK-processed surimi)	2,000	7,500	8,500	8,500	8,500	NA
Gyoniku (Fish) Sausage Association (ROK-processed surimi)		1,000	1,000	1,000	1,000	NA
Overseas Fishery Development quota[4] (Surimi from all countries)			100,000	0	200,000	NA
Total	22,000	73,500	109,500	37,500	209,500	421,500

[1]Japan's fiscal year extends from April through March of the following year. Pollock and pollock surimi quotas are allocated twice each year—the first allocation covering April through September and the second covering October through March.
[2]As of April 1987 this quota was incorporated into the Overseas Fisheries Development quota.
[3]May include other processed pollock products.
[4]Issued for the first time in April 1987.

Exports

The appreciation of the yen from a rate of ¥240/$1 in 1985 to ¥125/$1 in 1988 damaged Japan's world export share in many commodities by raising their prices to potentially uncompetitive levels. Although other sectors of the Japanese economy have weathered this crisis by cutting costs and streamlining production, the surimi industry, already hit by high costs caused by inadequate access to fishery resources worldwide, has been severely disadvantaged. Consequently, surimi exports to the United States declined from about 6,000 t in 1986 to only 800 t in 1988 (Table 11). Imitation crabmeat exports also declined precipitously in the past year, with exports to the United States decreasing by one half (Table 12). In response to these trends, the Japanese producers have shifted their export focus to the rapidly expanding European market. Surimi exports to Europe rose by 50 percent in 1987, and accounted for 40 percent of total Japanese fishery exports in 1988. However, this increase was not large enough to offset an overall decline in Japanese world surimi market share in both 1987 and 1988.

Table 11.—U.S. surimi supply by domestic production, imports, exports, and quantity, 1980-89.

Year	Domestic production	Imports (t) from: Japan	Other[1]	Total	Exports
1980		703			
1981		829			
1982		1,114			
1983		1,708			
1984		2,306			
1985		4,801	122	4,923	
1986	4,000	6,056	1,528	7,584	
1987	18,000	1,000	2,165	3,165	5,500
1988	57,200	800	2,000	3,500	30,500
1989[2]	141,000	400	500	900	106,000

[1]Primarily from South Korea, with small amounts from New Zealand.
[2]Projected.

Table 12.—Japanese exports of imitation crabmeat by country, quantity, and year, 1982-88.

Year	Exports (1,000 t) U.S.	Canada	Europe	Aust.	Other	Total
1982	6.7		0.5	1.8	0.3	9.3
1983	13.8	0.2	2.8	1.6	0.4	18.8
1984	26.8	0.8	2.3	1.6	1.0	32.5
1985	30.9	1.4	3.8	1.9	1.0	39.0
1986	25.3	1.9	5.8	1.6	1.1	35.7
1987	17.6	1.8	7.1	1.1	0.8	28.4
1988	8.7	1.7	7.5	1.3	0.6	21.1

Current and Future Developments

To gain access to hoki, jack mackerel, and southern demersal stocks, Japanese producers have increasingly been turning to South American countries, especially Argentina and Chile. Japanese vessels have been using Chilean jack mackerel to produce surimi for several years. Five Japanese vessels began producing hoki and southern blue whiting surimi in Argentine waters in 1987, but this project reportedly lapsed in 1989. The Japanese company Nippon Suisan expected to begin experimental surimi production of about 3,000-4,000 t through a joint venture with the Argentine company Mejino in 1989. Pacific hake joint ventures with Canada were also on the rise, accounting for a projected 6,000 t of surimi in 1989.

In addition, several unprecedented agreements were signed or discussed with the Soviet Union in 1988 for the initiation of Alaska pollock joint ventures in eastern Siberia and on the Sakhalin Island in the Northwest Pacific. The potential for future joint ventures with the Soviet Union, which has been enthusiastically pursuing closer economic ties with Japan since beginning business restructuring moves in 1986, is great. Joint ventures with New Zealand are also likely to increase because of the 75 percent cut in the Japanese hoki catch allocation in New Zealand waters for 1989.

In contrast, joint ventures with the United States are on a downward trend. Over the last 2 years, the United States has sharply reduced U.S. joint venture processing allocations (JVP) to the Japanese to keep pace with the raw material requirements of the rapidly expanding U.S. surimi industry. JVP's are the maximum round-weight amount of a particular species that the Japanese are permitted to buy over-the-side from U.S. vessels within the U.S. EEZ. The 1989 Alaska pollock JVP allocations, reflecting the 79 percent growth in the U.S. domestic surimi production since 1988, have been reduced from 504,000 t in round weight (20,000 t in surimi weight) in 1989 (Table 6). Total Japanese joint venture surimi production was expected to decline from 141,000 t in 1988 to 52,000 t in 1989.

Growing competition from South Korea in both domestic and JV surimi productions also has industry sources concerned. Some U.S. competitors fear that cheap South Korean surimi may be profitably reexported by Japan, but the Japanese producers believe that it will glut an already stagnating market, resulting in a further harm to the industry. They also fear that a recently concluded JV agreement between a South Korean company and the Soviet Union presages a trend toward Japanese exclusion from cooperative surimi production opportunities with the Soviet Union. The agreement permits South Koreans to enter traditional Japanese pollock fishing regions for maintenance privileges for Soviet factor vessels in Korean shipyards.

The outlook for the Japanese surimi industry is thus bleak. Although the search continues for a fish species to use as an alternative raw material to Alaska pollock, few can be turned at low cost into the white, high-quality surimi preferred by the Japanese. In addition, the high yen, U.S. and Korean competition, and adequate supplies of raw materials are likely to grow more problematic with time. The era of Japanese predominance in the surimi industry may be reaching its end.

The Republic of Korea

The most significant development in the Asian surimi industry has been the rapid rise of the Republic of Korea (ROK) as a major independent producer and exporter of surimi and analog products. It is the only Asian surimi industry which does not depend on Japanese technical assistance and aid. Production has more than tripled over the last 8 years, as ROK surimi, boosted by the fall of the won against the yen, has succeeded in penetrating not only the Japanese domestic market, but also markets in Europe and North America. The South Korean industry, however, must overcome not only the challenges of reduced access to raw materials in the U.S. and Soviet EEZ's and growing U.S. competition, but also a reputation for poor quality. In addition, an increasing domestic consumption rate may also limit the growth of ROK's world export share.

Raw Materials

The South Korean surimi industry, like Japan's, is primarily based on walleye pollock utilization. In contrast to Japan, however, ROK pollock catches rose steadily during the 1980's (from about 367,000 t in 1983 to 726,000 t in 1987). Since 1988, however, reduced access to raw materials from the U.S. EEZ has forced Korea also to move operations to the Bering Sea and New Zealand, and to turn to joint ventures with European countries, the Soviet Union, and the United States. Statistics for 1988 reveal a 25 percent decrease in Alaska pollock catch to 181,500 t. Despite this, the ROK continues to be a net exporter of walleye pollock, with 30 percent of its catch being exported in fillet form. Exports go mainly to the United States and Japan. In 1989, about 36 ROK vessels are operating in U.S. waters, through JV agreements with U.S. companies. South Korean-U.S. JM pollock production increased from 98,000 t in 1984 to 452,000 t in 1987, but has declined since then to 389,000 t in 1988, and an estimated 270,000 t in 1989. In one recent JV, a South Korean company has agreed to purchase 86,000 t of pollock from the Soviets off the western coast of the Kamchatka Peninsula. Joint ventures with North Korea, although still on a small scale, are also on the rise, with pollock constituting one of the most significant commodities in the growing North-South trade.

Table 13.—Korean frozen surimi production facilities by company.

Company[1]	Vessel name[1]	Vessel size (GRT)(t)	Daily capacity (t)
Goyo Fishery	Goyogo	5,377	40
Korei Deepsea	Keiyogo	5,377	60
	Kaitakugo	28,000	170
Namboku	Nambokugo	5,549	40
Toei Sangyo	Tosango	4,347	60
Sanko Bussan	Taihakugo	5,510	45
Shinro Koeki	Shinango	5,689	80
Dairin Fishery	#52 Daishingo	4,050	35
Nanyosha	Sunflower	3,200	30

[1]Names in Japanese pronunciation; mention of trade names or commercial firms in this article does not imply endorsement by NMFS, NOAA.

Production

At-sea surimi production began in 1984 aboard three vessels with a yearly capacity of only 14,000 t. The capacity of the fleet doubled in 1986 with the addition of 3 factory ships. Nine factory vessels and 185 shore-based processing plants were operating in mid-1989, to produce about 50,000 t of surimi per year (Table 13). Analog production, including imitation crab, has increased from 69,000 t in 1985 to 87,120 t in 1988. Although the maximum production capacity of the Korean industry is still small compared to Japan's, it has benefited greatly from the recent fall of the Korean won against the yen, and is expanding rapidly. Domestic consumption of surimi-based foods is increasing as the ROK population grows more affluent and demands more non-traditional, higher-quality foods, such as imitation crabmeat.

Imports

ROK imported a small amount of surimi for the first time in 1988, when a South Korean importer purchased 5,000 t from the Great Land Seafoods Company of the United States. To supply its growing domestic market, the industry will probably be forced to import more in the future.

Exports

South Korean exports of surimi to the United States have grown dramatically since 1985; they increased from 122 t in 1985 to 2,000 t in 1987 (Table 11). During the same period, ROK surimi

exports to Japan increased from 4,000 t to 8,000 t. In 1988, total ROK exports of imitation crabmeat approached 20,000 t. Exports to the United States and Japan may be stabilizing because of a stagnating market on the one hand and growing domestic competition on the other. However, ROK surimi exports to Europe are growing rapidly.

Current and Future Developments

ROK faces the same difficulties as Japan in terms of access to foreign surimi raw material resources. Joint venture allocations with the United States are on a downward trend, as the pollock requirements of the U.S. surimi industry increase. However, future South Korean supplies of pollock may be influenced by political developments. Although ROK does not maintain diplomatic relations with any Communist nation, it is actively pursuing closer economic ties in many sectors of its economy with the Soviet Union, the East European countries, China, and North Korea. As surimi JV's are a common avenue for economic exchange, the industry stands to benefit from improved relations. The ROK is also focusing on Europe as a major JV base and export market. Several joint ventures with European companies, such as Demaine Bros. in France, have already been signed. To date, however, Korea has not done as well in either the Japanese or European market as in the United States market, because of the poorer quality of its surimi. Quality, access to raw materials, and domestic consumption are three factors that the South Korean industry must stabilize to continue expanding its position in the world surimi market.

Thailand

Fish jelly products, such as fish balls and fish satay, have a long history in Thailand. Barracuda, sea eel, and sole were traditionally the main raw materials, but today threadfin bream and croaker, available in much larger quantities, are the most commonly utilized species. The Thai surimi industry is developing quickly and exported more surimi to Japan in 1988 than did South Korea. At present, however, the Thai surimi industry is still dependent on Japanese technical assistance.

Raw Materials

Thai production is based on threadfin bream, *Nemipterus japonicus*, because it is the most abundant raw material found in Thailand's waters and because it also exhibits the proper characteristics for processing export-quality surimi. Thailand's yearly supply of raw materials was estimated at about 1.1 million t for 1987. The yield of surimi from the threadfin bream is the same as the yield from walleye pollock—about 22-24 percent of whole weight—but the flesh is slightly darker and oilier, making it a somewhat less desirable product than pollock surimi.

Production

Surimi processing remained a small industry throughout the 1970's, with three surimi plants producing only 2,000 t annually. Since 1983, however, demand for and output of surimi products has increased dramatically. To date, there are 11 plants in operation, producing 20,000-25,000 t yearly. The rapid growth is due to the expanding Japanese market for cheap, lower-quality imported surimi, as well as the rising domestic demand for new products such as fish noodles and fish sausage. Although the Thai Government does not compile statistics on domestic consumption, industry sources believe that 3,000-4,000 t of surimi will be used by Thai food processors, including 1,000 t for imitation crabmeat in 1989.

Imports and Exports

Thailand imports no surimi raw materials and only a small amount of imitation crabmeat. Exports, on the other hand, have been growing steadily over the last few years, increasing from about 11,000 t in 1985 to 20,500 in 1987. Thai exporters hope to sell nearly 30,000 t of surimi to Japanese companies in 1989. About 80-90 percent of Thai surimi goes to Japan, while 10-20 percent goes to the United States, Singapore, and Europe.

Current and Future Developments

The future of the Thai industry hinges on technological improvements and resource management. Thai surimi is particularly disadvantaged in the Japanese market because of its low quality compared to the South Korean product. The industry is currently receiving technical assistance from the All-Japan Federation of Kamaboko Manufacturers Associations (Zenkama), and from Japanese buyers such as Hiraki Corporation. Because of the tropical climate, Thai producers must emphasize reduced landing times and improved icing and freezing of raw materials. Modern plants and equipment, as well as improved worker hygiene levels, are also necessary to ensure that the produce passes the microbiological standards of importing countries.

According to the Thai Government, Thailand may also have to deal with declining resources, especially in the Gulf of Thailand. In 1963, fishing effort for threadfin bream yielded 276 kg of fish per hour. In 1988, only 80 kg per hour were caught. Joint ventures and exploitation of the previously unutilized Andaman Bay waters have been identified as possible countermeasures. SIFCO Corporation, Thailand's largest surimi producer, has been involved with Japanese assistance since 1987 in many successful efforts to upgrade the quality and supply of its surimi.

New Zealand

New Zealand was the world's fourth largest producer of surimi in 1987, representing 3 percent of the estimated world production. New Zealand's rise to this position was rapid and was due primarily to the growing Japanese demand for New Zealand hoki, *Macruronus novaezelandiae*, to help offset the expected decline in pollock supplies. All New Zealand's surimi operations, however, are joint ventures with Japanese or Korean companies.

Raw Materials

Hoki is excellent for surimi because of its high gel-forming capability, abundance, and good color. It constitutes New Zealand's largest commercial fishery,

and is considered to be the second-largest surimi resource after walleye pollock, with a biomass of about 1.5 million t. It is covered by one of the seven New Zealand TAC (Total Allowable Catch) allocations, usually set at 200,000 t. Because of rising foreign demand, hoki catches by both foreign and domestic vessels more than doubled from 91,000 t in 1986 to 210,000 t in 1988. A stated concern about stock depletion, however, as well as a desire to promote the domestic surimi industry, has led the New Zealand Government to consider abolishing the Japanese and Korean hoki catch allocations. Also, New Zealand fishermen, handling hoki for export, object to foreign allocations. Japan's 1989 allocation has been reduced to 2,899 t, only 26 percent of its 1988 level, and industry sources expect the allocation to be phased out entirely within the next few years. Should this occur, the Japanese and the Koreans will be forced to depend upon joint ventures and imports for future access to New Zealand's hoki resource.

Production

New Zealand's hoki surimi production began in 1986 at 5,700 t, and rose to 17,300 t by 1987. One Korean and 15 Japanese factory vessels, under charter to 6 New Zealand companies, produced a total of 28,000 t of surimi in 1988. A small amount (3,000 t) of southern blue whiting surimi was also produced. Fletcher Fishing, Amaltal, Independent Fishing, and Skeggs companies are the largest surimi producers in New Zealand. Most New Zealand surimi is of the highest quality, valued in 1988 at \$3.40-3.50 per kg. There is a limited consumption of surimi-based products in New Zealand. It is estimated that the total market is worth about \$2.7 million annually—mostly supplied by imports from Japan. However, industry sources expect that domestic production will expand in response to both rising domestic consumption and high potential export earnings.

Imports and Exports

Nearly the entire New Zealand domestic production is exported to Japan, although some is also shipped to Australia, Singapore, and the United States. Many producers hope to emulate the success of the U.S. surimi industry and make surimi a major fisheries export earner for New Zealand.

Current and Future Developments

The development of an independent New Zealand industry will largely depend upon future foreign fishing allocations for hoki. If the allocation is cut completely, the New Zealand industry is likely to benefit from joint ventures and technology transfers from Japanese and South Korean companies. There is a strong desire within the industry to follow the example of U.S. producers, who used Japanese technical expertise to build a strong domestic industry. Some New Zealand companies are requesting subsidization from the government to develop the domestic surimi industry which, they claim, has the potential to produce as much as 15 percent of the world's surimi supply. To date, however, the industry has not received any government subsidies.

Note: There are considerable discrepancies between U.S. and Japanese statistics for Japan's surimi production and imports. These are mainly due to a difference in U.S. and Japanese attitudes toward Japan's surimi joint venture production with other countries. In joint ventures, surimi is generally produced by Japanese-owned factory vessels using fish purchased over-the-side from foreign vessels in foreign waters. In Japanese statistics, all joint venture production is included as imports, and is clearly differentiated in our main source, the *Minato shimbun*, from the domestic Japanese production, despite the fact that the surimi is produced by Japanese companies. In this report, because we have primarily utilized Japanese sources, we have followed the Japanese custom of referring to JV surimi production as imports. Other reports, however, may include JV production in Japanese domestic production, thus resulting in much higher domestic production figures than are used in this report. (Source: IFR-89/73, prepared by Karen L. Kelsky, Foreign Affairs Assistant, Foreign Fisheries Analysis Branch (F/IA23), National Marine Fisheries Service, NOAA, Silver Spring, MD 20910.)

The Fisheries of Denmark

Introduction

Danish fishermen increased their landings of fish and shellfish 17 percent by quantity to 1.8 million metric tons (t) but the value of the catch decreased 2 percent to about \$504 million[1] in 1988. Landings of edible fish decreased slightly to 0.3 million t, while landings of fish for reduction into fishmeal and oil, increased by more than 20 percent, to 1.5 million t. Danish exports of fish and shellfish products totalled \$1.9 billion, some 3 percent above 1987, giving the country a trade surplus of \$0.9 billion. The European Community (EC) was Denmark's most important market, purchasing nearly 70 percent of the country's total fishery exports in 1988. The Federal Republic of Germany is the largest single destination for Danish seafood exports. Danish imports of fishery products amounted to 0.6 million t worth \$0.8 billion.

[1]Value figures are shown in United States dollars, based exchange rates reported by the U.S. Treasury (US\$1.00 = 6.660 Danish krone), for 1988.

Government Programs

Resource Management

As an EC Member State, Denmark is required to faithfully execute the terms and provisions of the EC's Common Fisheries Policy (CFP) and other EC regulations and directives. Danish Fisheries Minister Lars Gammelgaard and members of his staff administer several programs designed to maintain or expand fishing opportunities for Danish fishermen, while at the same time ensuring that Danish quotas allocated under the CFP are not exceeded. Some of the management programs initiated in 1987-88 include the following items.

Quotas

A seasonal division for EC quotas allocated to Denmark was established. Fishermen also were allowed to supplement their catch quotas for cod, haddock, and saithe as well as herring and mackerel in the pelagic fisheries. Minimum fish sizes for cod, haddock, saithe, and plaice were increased in 1987 and 1988.

Vessel Limitations

Access to sprat stocks was restricted to vessels under 19 m in Kattegat and under 22 m in Skagerak. These smaller sized vessels were prohibited from catching herring and from fishing in other waters. Vessels over 22 m were granted access to "industrial" fish species (for reduction to fishmeal and oil), but not to sprat stocks.

North Sea and Greenland

Herring and mackerel fishing by purse seiners in the North Sea and shrimp fishing in the waters off Greenland were managed by means of a licence system based on a quota per vessel. Regulatory measures were also adopted for coastal fishing.

Financial Aid to the Industry

The Danish Government extended about $1 million in grants to develop or improve plants processing or storing fish and fishery products for human consumption. These Danish grants were made in accordance with EC Regulations (355/77) which identify specific areas where subsidy programs may be given as part of the CFP. The grants are limited to a maximum of 25 percent of project costs.

The Danish Government in 1988, also approved about $1.6 million in grants to improve the profitability of the Danish fleet and to upgrade the quality of the raw material being delivered to processing plants. These grants are allocated for modernization of fishery vessels. According to EC regulations (4028/86), smaller sized fishing vessels (less than 12 m) can obtain financial support on the same conditions as larger vessels (those over 12 meters). Grants are designed to speed the introduction of new and improved technology: more effective fishing techniques, faster fish handling, energy savings, and improved safety for fishermen. Under the provisions of the 1988 annual Appropriation Acts, grants of $705,000 were allocated to promote experimental fisheries and grants of $90,000 were given to Danish aquaculture projects (representing 10 percent of project costs), in accordance with EC Regulations (4028/86).

The Royal Danish Fisheries Bank (Kongeriget Danemarks Fiskeribank) provided $38 million in loans in 1988, of up to 70 percent of the construction costs of new fishing vessels, and of up to 60 percent of costs of purchasing second-hand vessels. The Fisheries Bank also granted loans to cover as much as 60 percent of the cost for the purchase of processing plants and machinery. Interest rates for the loans corresponded to the market rates of interest and repayment is scheduled over 10-20 years.

Fishing Fleet Reduction

The EC published regulations for reducing the fishing capacity of the EC fishing fleet in 1985. The result, for Denmark, has been a substantial reduction in both the number of licenses granted to fishermen and in the number of new vessels allowed to join the Danish fishing fleet. The main elements of the EC regulations as they apply to Denmark are: 1) Only allow entry of vessels of the same capacity to replace vessels withdrawn from the fleet; and 2) Within a limit of 15 percent of the reduction in the fleet capacity to allow building of new fishing vessels, modernization which increases the capacity by less than 15 percent, and vessels which are used exclusively to fish noncritical stocks (stocks for which there were no regulatory measures).

In implementing the EC directive, grants are available for the permanent withdrawal of vessels from fisheries within EC waters. A total of $6 million was appropriated for the years between 1984 and 1986 and $45 million for the years 1987 through 1991. Since the introduction of the program for the permanent withdrawal of vessels in 1987, the Danish fishing fleet has been reduced by about 7 percent, from 136,000 gross registered tons (GRT) to 126,000 GRT. No financial assistance was granted for the construction of new fishing vessels in 1987 and 1988.

International Agreements

The European Community is responsible for negotiating all international fishery agreements affecting Danish fishermen, including fishery agreements with the Faroe Islands and Greenland. Denmark, however, is responsible for conducting international negotiations on behalf of the Home-Rule Governments of both the Faroe Islands and Greenland. This sometimes places Denmark in the unique position of seeking to expand access for EC fishermen (i.e., Danish fishermen) in waters off Greenland, for example, while, at the same time, being responsible for reducing EC fishing in these same waters.

Denmark also has concluded fishery agreements with Norway and Sweden, within the framework of the EC Common Fisheries Policy, concerning fishing in the Skagerak and the Kattegat. In 1988, Sweden allocated to the EC 2,500 t of cod, 1,500 t of herring, and 170 t of salmon, in the contested "white zone" between Sweden and the Soviet Union. On 12 December 1988, however, a joint protocol was signed in Riga dividing up the "white zone" between Sweden and the Soviet Union, ending years of conflict between the two nations, but also ending EC access to the zone on 31 December 1988.

When it became apparent to Danish

fishermen that they would lose their access to the "white zone" off Sweden, they pressured the Danish Government to approach the EC to open negotiations with the Soviet Union to provide access to Soviet-controlled waters in the Baltic Sea. EC negotiators met with Soviet officials in Moscow on 8-9 September 1988. These were the first fishery talks between the EC and the Soviet Union since 1977, when the EC extended its international fishery boundaries, excluding the foreign fisheries. The opening of negotiations was an important step because for years the Soviet Union did not recognize the EC and refused to meet with EC fishery officials. Negotiations were continuing, but the results were not yet clear. Danish fishermen were particularly eager to receive permission to fish for cod in Soviet-controlled portions of the Baltic Sea.

Danish fishery interests with the neighboring German Democratic Republic (GDR) began a new era of cooperation when, on 14 September 1988, Danish officials and representatives of the GDR initialled an agreement recognizing Danish sovereignty over waters around the island of Bornholm and dividing the Continental Shelf and fishing zones between the two countries, ending a long dispute. The ratified agreement entered into force on 14 June 1989.

Sanitary Regulations

General regulations concerning the catching, storing, carrying, freezing, preserving, processing, and the sale of fish and shellfish products are codified in the Fisheries Act of Quality Control with Fish and Fisheries Products No. 339 of 29 May 1987. Control is carried out by the Danish Fish Inspection Service. In accordance with EC regulations, all Danish companies storing, handling and/or processing fish and fishery products must be authorized by the Ministry of Fisheries. By the end of 1988, there were about 400 plants authorized to store, handle, or process fishery products in Denmark. There were 108 firms registered in Greenland, including factory ships and several vessels which are able to cook shrimp using onboard equipment.

Quality is of great concern to Danish fishermen and processors because of the importance of the quality-conscious FRG market which accounts for nearly one-fifth of Danish exports. In 1987, reports of nematodes in fish were televised on West German television and fish consumption declined dramatically. On 8 August 1988, the FRG published new regulations on the handling and processing of fishery products. Danish fish processors were well prepared to meet or exceed these strict standards.

Imported fish and fishery products must comply with all EC regulations enforced in Denmark. Before importing any fish or shellfish product, an importer must notify the Danish Fish Inspection Service, which may perform laboratory control of samples. Fishery products destined for export are also covered by the sanitary regulations.

Aquaculture

Denmark had 635 registered fish farms in 1988, including 565 freshwater farms (mostly raising rainbow trout), 38 saltwater farms (mostly raising seatrout in salt water), and 32 farms devoted to raising European eels, *Anguilla rostrata*. Total aquaculture production has remained steady in recent years, mostly because of environmental concerns which led to a ban on establishing new fish farms. Because of this ban, no new fish farms have been established and expansion of existing saltwater installations has been prohibited since December 1986. As a result, Danish aquaculture harvests have changed little since 1985 (Table 1).

In 1988, Danish fish farms received permission from the FRG to sell their saltwater-raised trout as "salmon trout." The decision was not uniformly welcomed in West Germany, since it causes confusion among consumers. Danish fish farmers do not raise Atlantic salmon because restrictions on new fish farms have prevented culture of this high-valued species.

Fleet and Fishermen

The Danish fishing fleet consisted of 3,007 powered vessels in 1988, a decrease of 205 vessels from the 3,212 vessels registered in 1987 and the 3,243 vessels in 1986. The total tonnage of the Danish fleet declined by 7 percent, to 126,000 GRT in 1988, when compared to 1987. The decrease is due in large measure to the EC program to reduce the size of the members' fishing fleets. In 1988, Denmark was one of only two EC countries to meet the EC goal; fishing fleets in a number of other countries increased slightly, despite the EC programs.

The Danish fishing fleet is dominated by small vessels; more than two-thirds of the fleet consists of vessels below 25 GRT (Fig. 1). Most of the Danish fishing fleet operates out of ports on the island of Bornholm (285 vessels), followed by Friderikshaven (262 vessels), Esbjerg (208 vessels), Skagen (205 vessels), and Hirtchals (190 vessels). The remaining vessels were registered at 25 other ports in Denmark (Fig. 2).

By the end of 1988, there were about 8,000 fishermen registered in Denmark, including 2,200 who are members of the Danish Fishermen's Producers' Organization (DFPO) which was established in 1973, according to EC regulations for the Common Market Organization for fishery products. The DFPO guarantees its members certain minimum prices for

Table 1.—Denmark's aquaculture production by quantity, 1983-88.

	Harvest (t)			
Species	1985	1986	1987	1988
Trout				
Freshwater	24,000	24,000	23,000	22,500
Saltwater	3,300	3,600	3,700	5,200
European eel	NA	200	250	235
Total	27,300	27,800	26,950	27,935

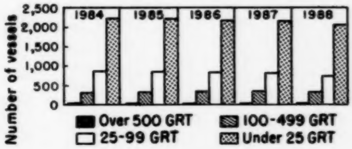

Figure 1.—Denmark's fishing fleet by number and size of vessels, 1984-88.

Figure 2.—Principal fishing ports of Denmark.

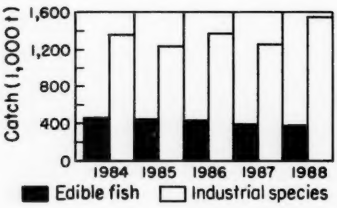

Figure 3.—Denmark's fishery catch by quantity, 1980-88.

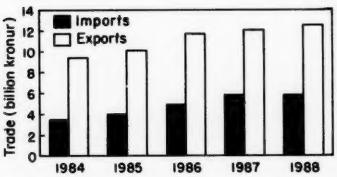

Figure 4.—Denmark's trade in fishery products by value, 1984-88.

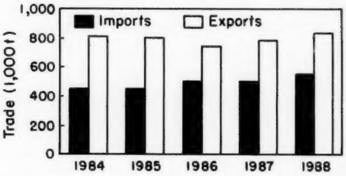

Figure 5.—Denmark's trade in fishery products by quantity, 1984-88.

Table 2.—Fisheries landings by Danish vessels, in domestic and foreign ports, by quantity, 1986-88.

	Landings[1] (1,000 t)		
Species	1986	1987	1988
Edible			
Cod	136	132	113
Herring	80	66	92
Plaice	39	36	31
Mackerel	22	27	25
Haddock	17	9	10
Saithe	9	6	6
Norway lobster	3	3	2
Hake	3	2	1
Whiting	2	1	1
Common sole	1	1	1
Atlantic salmon	1	1	1
Other	123	118	106
Subtotal	436	402	389
Nonedible[2] Subtotal	1,365	1,244	1,532
Total catch	1,801	1,646	1,921

[1]Figures may not agree because of rounding of edible species.
[2]Industrial fish species for reduction into fishmeal and oil.

their landings of fish. Two other organizations, the Purse Seiners' Producers Organization and the Skagen Fishermen's Producers' Organization, also provide price supports to their members.

Landings

Danish landings of fish and shellfish have averaged about 1.8 million t during the past decade. Landings peaked at 2.0 million t in 1980 and declined to 1.7 million t in 1987. In 1988, total landings by Danish fishermen in Danish ports increased by 17 percent to 1.9 million tons. This was a recovery from the 1.7 million t harvested in 1985, but is below the 2 million t caught in 1980. Landings of fish and shellfish destined for human consumption, however, decreased by some 3 percent to 389,000 t (Fig. 3, Table 2).

Most of the Danish fisheries catch is made in the North Sea (72 percent), Skagerrak (12 percent), Kattegat (5 percent) and Baltic Sea (6 percent). Danish landings in domestic ports were valued at $504 million, 2 percent below the value of landings in 1987. The principal ports where most of the Danish fish catch was landed in 1987, included: Esbjerg (687,000 t), Thyboron (234,000 t), Hirtshals (171,000 t), Skagen (149,000 t), Hanstholm (52,000 t), and Hvide Sande (43,000 t). Landings of edible fishery products were worth $360 million, while industrial species used to make fishmeal and oil were valued at $144 million, in 1988. Landings of fish for reduction into fishmeal and oil increased to 1.5 million t in 1988, 20 percent above 1987 landings. The landings yielded 338,000 t of fishmeal in 1988, versus 270,000 t in 1987 and 302,000 t in 1986. It is noteworthy that three-fourths of Danish landings, by quantity, consist of fish for reduction which contribute less than one-third of the value of the entire catch; meanwhile, fish for human consumption, one-fourth of landings, account for over two-thirds of the value of the harvest. It is also noteworthy that the catch of fish and shellfish for human consumption is gradually decreasing in Denmark. In addition to Danish landings in domestic ports, foreign fishermen also unload their catches in Danish ports and Danish fishermen also land a portion of their catch in foreign ports.

Trade

Denmark is one of Europe's leading seafood exporters, importing low-value raw material and exporting high-value finished seafood products. During the past 5 years, Danish exports have remained important, providing the country with a source of foreign exchange. However, the seafood industry is relying more and more on imported fishery products to maintain its processing plants. Imports have gradually increased in recent years as compared with stable export levels (Fig. 4, 5).

Imports

Danish imports of fish and fishery products amounted to some 550,000 t in 1988, vs. 494,000 t in 1987 and 454,000 t in 1986. Danish imports have been growing at about 10 percent per annum during the last few years. The value of Denmark's imports, however, remained stable at $870 million in 1988. Shrimp

was the most important item; imports of shrimp amounted to $330 million in 1988, representing almost 40 percent of total Danish imports in value terms.

In 1988, U.S. seafood dealers exported 1,992 t of fishery products valued at $10.7 million to Denmark. This include $6 million worth of chum salmon and $1.5 million worth of other salmon (including fillets, canned salmon, and salmon roe). Danish importers also purchased $1.8 million worth of seaweeds from the United States in 1988. The U.S. Embassy in Copenhagen in 1987, reported that the best prospects for U.S. suppliers in Denmark include whitefish fillets, eels, salmon roe, lobster, and crayfish.

Exports

Danish exports of fish and shellfish products amounted to 823,300 t in 1988, a 5 percent increase over 1987 exports of 804,000 t. Fishery exports were worth about $1.7 billion, some 3 percent above 1987. Canned or prepared seafoods were the most valuable commodities, earning $375 million, 11 percent above corresponding 1987 levels. Shrimp was by far the most important item in this group, representing a total value of $165 million. Uncertain market conditions for traditional groundfish products, such as cod and haddock, have depressed Denmark's export earnings from frozen fillets which dropped from $405 million in 1987 to $315 million in 1988. Other important export earning commodity groups include shellfish, cured fish, whole fish (fresh and chilled) and freshwater fish (mostly trout).

In 1988, exports of fishmeal increased both in terms of value and quantity. A total of 252,373 t was exported in 1988, 26 percent above the 200,000 t exported in 1987 and 225,000 exported in 1986. The value of Danish fishmeal exports was $150 million in 1988.

The European Community was by far the most important market for Danish fishery products in 1988, purchasing $1.3 billion worth of Danish fishery exports, equivalent to 70 percent of Denmark's total export earnings. The FRG was the largest single market for Danish fishery exports in 1988, accounting for $348 million, or nearly one-fifth of total exports. Danish exports to the UK increased from $197 million in 1987 to $204 million in 1988.

Outside the EC the main market outlets for Danish fishery products, by value, in 1988 were: Japan (7 percent, $139 million), Sweden (6 percent), Switzerland (5 percent), and the United States (4 percent or $72 million, down from $138 million in 1987). The weaker U.S. dollar and the lower prices for frozen cod blocks in the U.S. market contributed to the decline in sales of Danish fishery products in the United States.

Outlook

Danish fishermen are being caught in an increasingly tight squeeze. Fishing quotas for profitable species (such as cod) are growing smaller while restrictions on fishing grounds, seasons, net sizes, etc., increase. The EC is reducing the size of the Danish fishing fleet. Competition, from countries such as Iceland and Norway, has grown in recent years, further increasing pressure to reduce prices on many traditional fish species. Danish fishermen are experiencing difficulty in providing consumers, processors, and export markets with supplies of desired species from domestic fishermen. The rising demand for fishery products is forcing suppliers to increase imports. Limitation on aquaculture suggests that Danish processors will have little option but to import in the coming years.

The long-term outlook for many Danish fishermen is not optimistic. Most of the fleet (2,015 vessels) consists of small fishing vessels (mostly under 25 GRT); these vessels cannot take advantage of distant fishing grounds where EC negotiations have succeeded in obtaining access for member fishing vessels. There is little chance that stocks of fish in Danish waters or in neighboring waters will increase substantially in the near future, although some fishermen hold out the hope that the EC will be able to negotiate access to the Soviet Baltic waters.

The Danish fleet includes 299 vessels over 100 GRT that can sail to distant fishing grounds. In 1988, several Danish fishermen decided that fishing in the North Sea had become too difficult and set sail for the Indian Ocean where they attempted to fish for tuna. In 1989, it was announced that 20 licenses have been issued to Danish fishermen allowing them to fish in waters off Tanzania and Zanzibar in East Africa. The licenses were obtained by an Anglo-Danish group. Danish fishermen will be allowed to fish for tuna, swordfish, spiny lobster, and shrimp. Vessels participating in this fishery will fly the Danish flag, but must land their catch for processing ashore in the host country. Thus, for larger vessels, the future might be more attractive in distant waters where skilled Danish fishermen can use their experience to assist developing countries expand their fisheries—a mutually profitable endeavor. (Source; IFR-89/89, prepared by William B. Folsom, Office of International Affairs, National Marine Fisheries Service, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

New Technical Reports

NOAA Technical Report NMFS 77. Keppner, Edwin J., and Armen C. Tarjan. **"Illustrated key to the genera of free-living marine nematodes of the order Enoplida."** July 1989, iii + 26 p., 118 figs.

ABSTRACT

A pictorial key to 118 genera of free-living marine nematodes in the order Enoplida is presented. Specific morphological and anatomical features are illustrated to facilitate use of the key. The purpose of this work is to provide a single key to the genera of enoplid nematodes to facilitate identification of these organisms by nematologists and marine biologists working with meiofauna.

NOAA Technical Report NMFS 78. Pearson, Donald E. **"Survey of fishes and water properties of South San Francisco Bay, California, 1973-82."** August 1989, iv + 21 p., 8 figs., 7 tables, 5 app. tables.

ABSTRACT

The objective of this study was to describe the physical and ichthyological changes occurring seasonally and annually in the south San Francisco Bay, based on the results of 2,561 otter trawl and water samples obtained between February 1973 and June 1982. Temperature varied predictably among seasons in a pattern that varied little between years. Salinity also underwent predictable seasonal changes but the pattern varied substantially between years. The most abundant species of fish were northern anchovy (*Engraulis mordax*), English sole (*Parophrys vetulus*), and shiner surfperch (*Cymatogaster aggregata*). The majority of the common fish species were most abundant during wet years and least abundant in dry years. Numeric diversity was highest during the spring and early summer, with no detectable interannual trends. Species composition changed extensively between seasons and between years, particularly years with extremely high or extremely low freshwater inflows. All the common species exhibited clustered spatial distributions. Such spatial clustering could affect the interpretation of data from estuarine sampling programs. Gobies (Family Gobiidae) were more abundant during flood tides than during ebb tides. English sole were significantly more abundant in shallower areas. Shiner surfperch showed significant differences in abundance between sample areas.

NOAA Technical Reports NMFS 79. Wenner, Charles A., and George R. Sedberry. **"Species composition, distribution, and relative abundance of fishes in the coastal habitat off the southeastern United States."** July 1989, iii + 49 p., 35 figs., 6 tables, 1 app. table.

ABSTRACT

Ichthyofauna of the coastal (< 10 m depth) habitat of the South Atlantic Bight were investigated between Cape Fear, North Carolina, and St. John's River, Florida. Trawl collections from four nonconsecutive seasons in the period July 1980 to December 1982 indicated that the fish community is dominated by the family Sciaenidae, particularly juvenile forms. Spot (*Leiostomus xanthurus*) and Atlantic croaker (*Micropogonias undulatus*) were the two most abundant species and dominated catches during all seasons. Atlantic menhaden (*Brevoortia tyrannus*) was also very abundant, but only seasonally (winter and spring) dominant in the catches. Elasmobranch fishes, especially rajiforms and carcharinids, contributed to much of the biomass of fishes collected. Total fish abundance was greatest in winter and lowest in summer and was influenced by the seasonality of Atlantic menhaden and Atlantic croaker in the catches. Biomass was highest in spring and lowest in summer, and was influenced by biomass of spot. Fish density ranged from 321 individuals and 12.2 kg per hectare to 746 individuals and 25.2 kg per hectare. Most species ranged widely throughout the bight, and showed some evidence of seasonal migration. Species assemblages were dominated by ubiquitous year-round residents of the coastal waters of the bight. Diversity (H′) was highest in summer, and appeared influenced by the evenness of distribution of individuals among species.

NOAA Technical Report NMFS 80. Matarese, Ann C., Arthur W. Kendall, Jr., Deborah M. Blood, and Beverly M. Vinter. **"Laboratory guide to early life history stages of Northeast Pacific fishes."** October 1989, iv + 642 p., 272 figs., 50 tables.

ABSTRACT

This laboratory guide presents taxonomic information on eggs and larvae of fishes of the Northeast Pacific Ocean (north of California) and the eastern Bering Sea. Included are early-life-history series, illustrations, and comparative descriptions of 232 species expected to spawn here, out of a total 627 species known to occur in marine waters of this area. Meristic and general life-history data are included, as well as diagnostic characters to help identify eggs and larvae. Most of this information has been gleaned from literature, with the addition of 200 previously unpublished illustrations.

NOAA Technical Report NMFS 81. Estrella, Bruce T., and Daniel J. McKiernan. **"Catch-per-unit-effort and biological parameters from the Massachusetts coastal lobster (*Homarus americanus*) resource: Description and trends."** September 1989, iv + 21 p., 11 figs., 27 tables.

ABSTRACT

A comprehensive description of the Massachusetts coastal lobster (*Homarus americanus*) resource was obtained by sampling commercial catches coastwide at sea and at dealerships between 1981 and 1986. A commercial lobster sea-sampling program, wherein six coastal regions were sampled monthly, with an areal and temporal data weighting design, was the primary source of data.

An improved index of catch per trap haul/set-over-day was generated by modeling the relationship between catch and immersion time and standardizing effort. This 6-year time-series of mean annual catch rates tracked closely the landings trend for territorial waters.

During the study period there was a gradual increase in indices of exploitation and total annual mortality which corresponded to a gradual decline in mean carapace length of marketable lobster. The frequency of culls escalated from 10.0% in 1981 to 20.9% in 1986, while the percentage of lobster found dead in traps was consistently less than 1%. The sex ratio (%F: %M) was significantly different from 50:50 and approximated a 60:40 relationship during the study period.

Male and female weight-length relationships were significantly different. Females weighed more than males at smaller sizes and less than males at larger sizes. A north-south clinal trend was evident wherein lobster north of Cape Cod weighed less at length than those from regions south of Cape Cod.

Functional size-maturity relationships were developed for female lobster by staging cement gland development. Proportions mature at size represent more realistic values than those obtained by analyses of percent of females ovigerous.

Regional variation occurred in most of the parameters studied. Three lobster groups, differing in major population descriptors, are defined by our data.

Editorial Guidelines for the *Marine Fisheries Review*

The *Marine Fisheries Review* publishes review articles, original research reports, significant progress reports, technical notes, and news articles on fisheries science, engineering, and economics, commercial and recreational fisheries, marine mammal studies, aquaculture, and U.S. and foreign fisheries developments. Emphasis, however, is on in-depth review articles and practical or applied aspects of marine fisheries rather than pure research.

Preferred paper length ranges from 4 to 12 printed pages (about 10-40 manuscript pages), although shorter and longer papers are sometimes accepted. Papers are normally printed within 4-6 months of acceptance. Publication is hastened when manuscripts conform to the following recommended guidelines.

The Manuscript

Submission of a manuscript to *Marine Fisheries Review* implies that the manuscript is the author's own work, has not been submitted for publication elsewhere, and is ready for publication as submitted. Commerce Department personnel should submit papers under a completed NOAA Form 25-700.

Manuscripts must be typed (double-spaced) on high-quality white bond paper and submitted with two duplicate (but not carbon) copies. The complete manuscript normally includes a title page, a short abstract (if needed), text, literature citations, tables, figure legends, footnotes, and the figures. The title page should carry the title and the name, department, institution or other affiliation, and complete address (plus current address if different) of the author(s). Manuscript pages should be numbered and have 1½-inch margins on all sides. Running heads are not used. An "Acknowledgments" section, if needed, may be placed at the end of the text. Use of appendices is discouraged.

Abstract and Headings

Keep titles, heading, subheadings, and the abstract short and clear. Abstracts should be short (one-half page or less) and double-spaced. Paper titles should be no longer than 60 characters; a four- to five-word (40 to 45 characters) title is ideal. Use heads sparingly, if at all. Heads should contain only 2-5 words; do not stack heads of different sizes.

Style

In style, the *Marine Fisheries Review* follows the "U.S. Government Printing Office Style Manual." Fish names follow the American Fisheries Society's Special Publication No. 12, "A List of Common and Scientific Names of Fishes from the United States and Canada," fourth edition, 1980. The "Merriam-Webster Third New International Dictionary" is used as the authority for correct spelling and word division. Only journal titles and scientific names (genera and species) should be italicized (underscored). Dates should be written as 3 November 1976. In text, literature is cited as Lynn and Reid (1968) or as (Lynn and Reid, 1968). Common abbreviations and symbols such as mm, m, g, ml, mg, and °C (without periods) may be used with numerals. Measurements are preferred in metric units; other equivalent units (i.e., fathoms, °F) may also be listed in parentheses.

Tables and Footnotes

Tables and footnotes should be typed separately and double-spaced. Tables should be numbered and referenced in text. Table headings and format should be consistent; do not use vertical rules.

Literature Cited

Title the list of references "Literature Cited" and include only published works or those actually in press. Citations must contain the complete title of the work, inclusive pagination, full journal title, and the year, month, volume, and issue numbers of the publication. Unpublished reports or manuscripts and personal communications must be footnoted. Include the title, author, pagination of the manuscript or report, and the address where it is on file. For personal communications, list the name, affiliation, and address of the communicator.

Citations should be double-spaced and listed alphabetically by the senior author's surname and initials. Co-authors should be listed by initials and surname. Where two or more citations have the same author(s), list them chronologically; where both author and year match on two or more, use lowercase alphabet to distinguish them (1969a, 1969b, 1969c, etc.).

Authors must double-check all literature cited; they alone are responsible for its accuracy.

Figures

All figures should be clearly identified with the author's name and figure number, if used. Figure legends should be brief and a copy may be taped to the back of the figure. Figures may or may not be numbered. Do not write on the back of photographs. Photographs should be black and white, 8 × 10 inches, sharply focused glossies of strong contrast. Potential cover photos are welcome, but their return cannot be guaranteed. Magnification listed for photomicrographs must match the figure submitted (a scale bar may be preferred).

Line art should be drawn with black India ink on white paper. Design, symbols, and lettering should be neat, legible, and simple. Avoid freehand lettering and heavy lettering and shading that could fill in when the figure is reduced. Consider column and page sizes when designing figures.

Finally

First-rate, professional papers are neat, accurate, and complete. Authors should proofread the manuscript for typographical errors and double-check its contents and appearance before submission. Mail the manuscript flat, first-class mail, to: Editor, *Marine Fisheries Review*, Scientific Publications Office, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E., Bin C15700, Seattle, WA 98115.

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